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CLIMATOLOGY OF AIRBLAST PROPAGATIONS FROM NEVADA TEST SITE NUCLEAR AIRBURSTS

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ABSTRACT

Microbarograph data from Nevada atmospheric nuclear tests of 1951-1962 have been assembled to show climatological patterns for long range propagations. Amplitudes have been normalized to 1-kiloton yield, free-airburst, after actual height-of-burst effects were removed.

On-site propagations under early morning inversions often showed double the amplitudes expected for standard hemispherical wave expansion. These enhanced blasts were blocked by mountains and did not penetrate off-site. Strong winds at higher altitudes gave as much as 5X blast magnifications at Indian Springs and Las Vegas.

Ducting at very high altitude, to 30 miles or 150,000 feet, is seasonally directed eastward in winter, westward in summer. Resulting amplitudes in the sound ring near 135 miles range show as large as 3X magnification downwind and 0.006X reduction upwind. On the average the annual cycling in east and west directions ranges from near standard, 1X, downwind amplitudes to 0.016X upwind amplitudes. The seasonal reversal periods when upper winds are nearly calm, occur about May 5 and September 20. At that time amplitudes in all directions shown an average 0.28X reduction below standard.

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Introduction

Now that several years have elapsed since atmospheric nuclear tests were last conducted at the Nevada Test Site (NTS), recollections of the characteristics of long-range airblast propagations have dimmed. However, during this time there have been significant improvements in understanding these phenomena. A review of our collection of microbarograph (MB) amplitudes is now appropriate in light of current concern over propagations predicted for the escalating yields of Plowshare cratering experiments.

This review will not go into detailed analysis or case studies. The main point is to present yield data which have now been declassified,[1] and normalize it to a reference yield of a 1-kiloton nuclear explosive (NE) free-airburst (FAB). Bursts at various heights above ground—on towers, on balloons, or from bombs dropped from airplanes—may have enhanced blast pressures where the ground-reflected shock overtakes and combines with the incident shock wave. This is described in The Effects of Nuclear Weapons,[2] and this fused shock, called the Mach stem, has higher overpressures which depend upon burst height, yield, and distance.

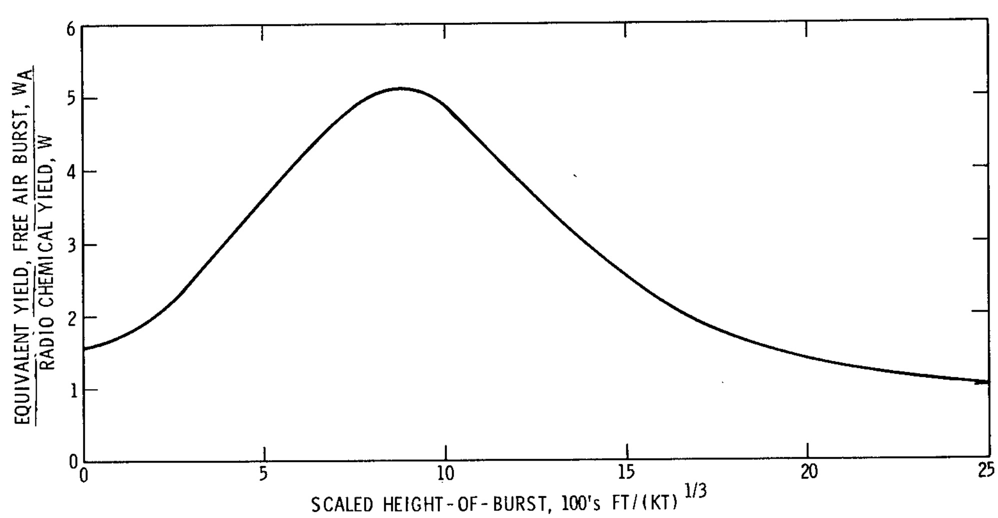

Figure 1. Height-of-Burst Effect on Airblasts from Nuclear Tests

Height-of-burst (HOB) effects have been removed from mb data by assuming that Mach stem wave strengths could be simulated by larger apparent yields, W_A. Actual burst height divided by the cube root of the radiochemical yield, $W^{1/3}$, gives scaled HOB. A function relating apparent yield enhancement to scaled HOB was generated from curves of HOB effects at the Δp = 2 lb/in.^{2} overpressure contour, and is shown in Figure 1. Experiment has shown[3] that these blast enhancements are carried to long ranges. Note that surface bursts are not exactly constrained to the model of a hemisphere and a perfectly reflecting plate, $W_A/W = 2$, because much energy is absorbed in cratering and ground shock. The "optimum" HOB for 1 kiloton is near 900 feet.

It was further assumed that wave overpressures and amplitudes decay inversely with distance, R, raised to the 1.2 power. The difference between $R^{-1.2}$ decay and acoustic R^{-1} decay is attributed to losses observed by experiments with unrefracted propagations. Distances to constant blast pressure are scaled in proportion to $W^{1/3}$, and the result is, for power law decay, that, at a fixed distance, amplitudes increase in proportion to $W^{0.4}$.

Reported yields and HOB's have been used to calculate W_A and $W_A^{0.4}$ for each event, and each microbarogram amplitude has been appropriately reduced to W_A = 1 kiloton, NE FAB. The standard <u>incident</u> overpressure curve for this explosion yield at sea level ambient pressure, p = 1000 mb, and at $R \geq 9000$ feet, is

$$\Delta p \text{ mb} = 357 \text{ (R kilofeet)}^{-1.2} \quad ; \tag{1}$$

and for the altitude of NTS, using the CP-1 (Yucca Pass Control Point) elevation of 4144 feet MSL, standard pressure altitude p = 870 mb, is

$$\Delta p \text{ mb} = 328 \text{ (R kilofeet)}^{-1.2} \quad . \tag{2}$$

Peak-to-peak <u>incident</u> amplitude, p_k, used because it averages out some of the deviations, uncertainties, and nonrepeatabilities in both positive and negative phases at long range, is obtained by multiplying Δp at NTS altitude by 1.35 (from IBM Problem M),[4] so that

$$p_k \text{ mb} = 444 \text{ (R kilofeet)}^{-1.2} \quad . \tag{3}$$

In the distant field, ozonosphere signals often strike ground at relatively large incidence angles of up to 40 degrees above horizontal. They are nearly doubled by reflection because the ground is a near-perfect reflector of these wavelengths. Consequently,

reference curves for ozonosphere signals will be recorded, reflected amplitudes, p_k^*, where

$$p_k^* \text{ mb} = 888 \text{ (R kilofeet)}^{-1.2} \quad . \tag{4}$$

Troposphere Propagations

There are three paths for blast waves propagating to long range through the troposphere. One, when sound velocity decreases with altitude, is called the gradient situation, and wave rays are turned upward away from ground. No acoustic rays reach ground outside the range of direct rays from elevated bursts. Some blast energy scatters out into this "silent" area, however, and gives detectable amplitudes from large nuclear explosions even at long range. The pressure-distance decay rate is very rapid.

A second possible wave path is under a near-surface inversion which may generate from nighttime cooling in the air near ground level. A sound velocity inversion may also result from wind direction or velocity shears with height. For early morning shot times at NTS this was a normal ducting mode, as far as propagations through Yucca or Frenchman's Flats were concerned. Mountains usually prevented this ducting from spreading out with large amplitudes into surrounding communities.

The third path, and the one which caused concern for off-site safety from nuclear tests, is ducted downwind by jet stream or other high-wind speeds. This condition may cause considerable blast magnification at ranges up to 100 miles.

There has been no attempt to separate these modes of propagation in the data assemblages of Figures 2 through 5. In these figures points are connected where they represent stations in a general line, often toward Las Vegas, from the shot point. Some isolated points show values at other azimuths which do not conform to the pattern for other directions. Data from 11 events of Operation Upshot-Knothole are shown in Figure 2. Figure 3 presents data from events of Operation Teapot. Data from 23 Plumbbob and 17 Hardtack events are entered in Figures 3 and 4, respectively. In all of these figures there is too much overlap to allow clear identification of the curve for each event, so they have not been labeled. Microbarograph amplitude data are listed in the Appendix, if more detailed case studies are needed. It may be concluded that the low pressures and rapid decays with distance were associated with atmospheric gradient conditions for propagation. Very high amplitudes, in excess of standard at long range, were associated with ducting by high wind speeds at altitudes as high as 30,000 feet MSL. High pressures at

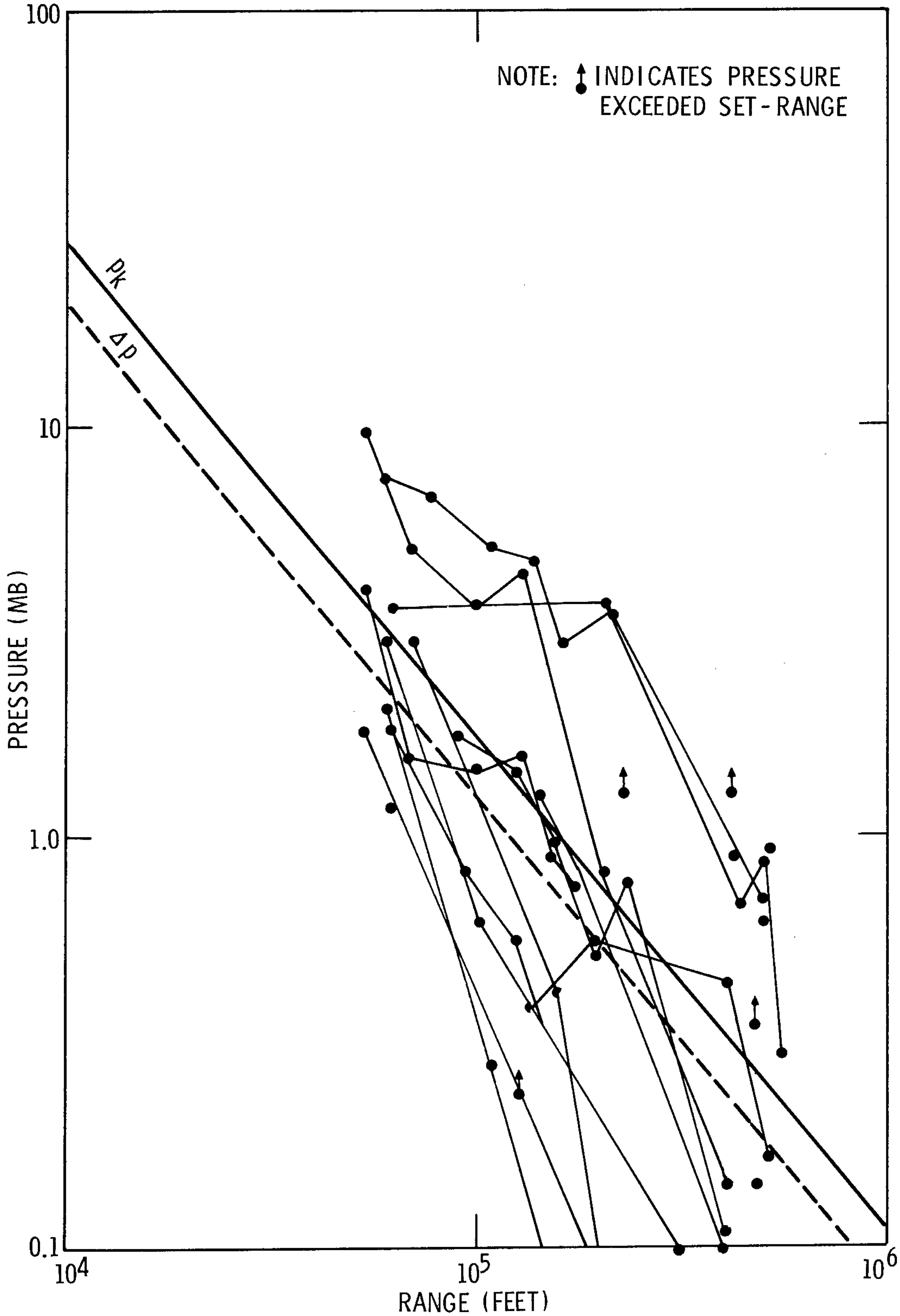

Figure 2. Summary of Troposphere Propagations, Upshot-Knothole, 3/17 - 6/4 1953

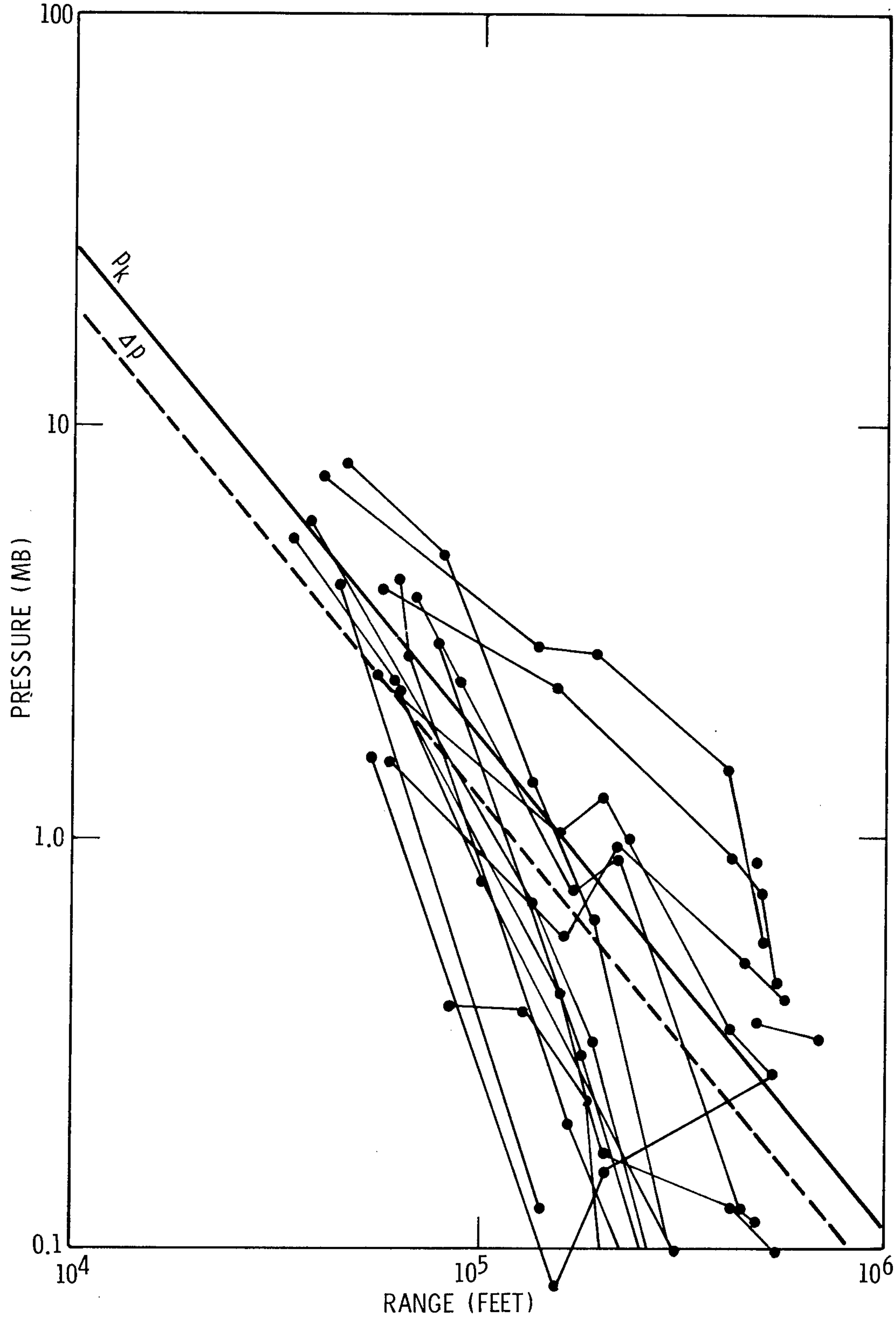

Figure 3. Summary of Troposphere Propagations, Teapot, 2/18 - 5/15 1955

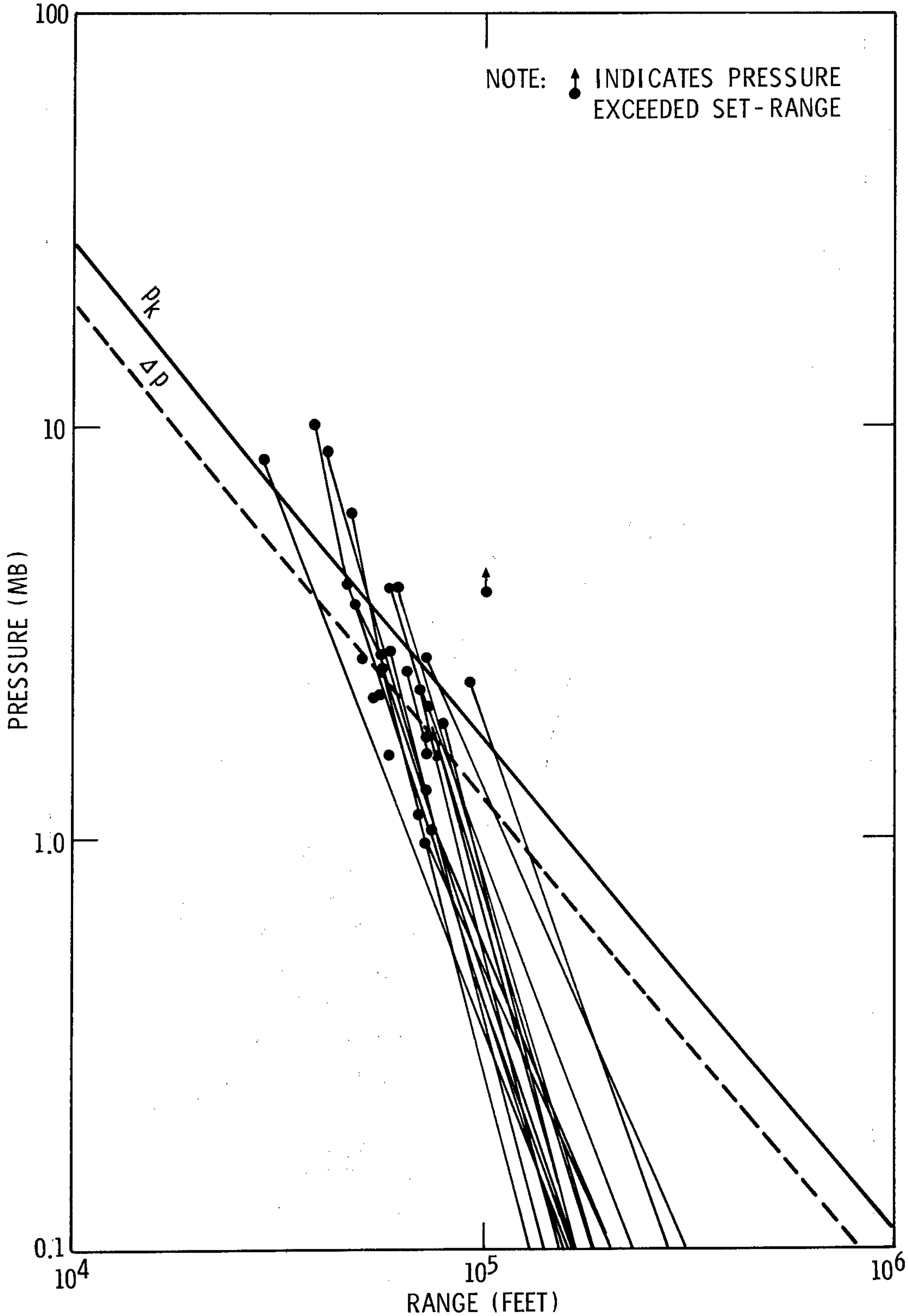

Figure 4. Summary of Troposphere Propagations, Plumbbob, 5/28 - 10/7 1957

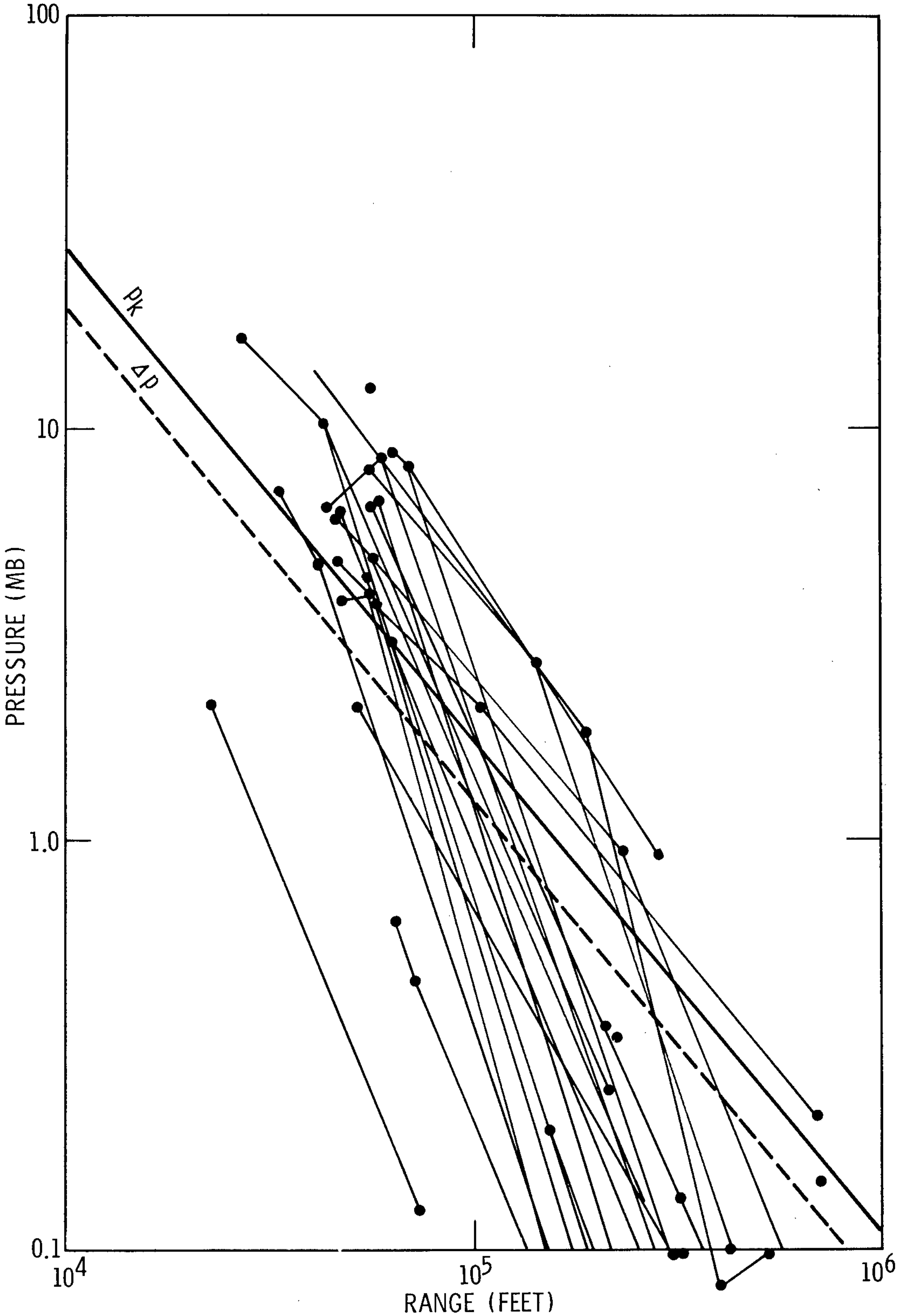

Figure 5. Summary of Troposphere Propagations, Hardtack II, 9/19 - 10/29 1958

intermediate ranges are attributable to surface inversion ducting. On occasion this extends to 40 miles. Beyond this intermediate range amplitudes drop rapidly with increased distance.

Large troposphere signal amplitudes were recorded at Las Vegas and Boulder City several times during Upshot-Knothole and Teapot. Jet streams are frequent visitors to Nevada skies during late winter and through the spring. The summer series, Plumbbob, had no case with even near-standard propagation into Las Vegas. This is as expected from consideration of atmospheric conditions with high surface temperatures, unstable temperature lapse rates, and relatively weak southwesterly summer winds aloft. During the autumn when Hardtack was conducted, there were a number of occasions of strong relative propagation, but shots in this series were mostly very small yields that resulted in no claims or damages. The one nominal-yield test which was planned was canceled lest it focus a strong airblast on Las Vegas, as was predicted by both ray trace calculations and numerous check shots of a ton or less high explosives.

Maximum propagations to long range through the troposphere reached magnifications of 5X, and were below the extremes found in the Blast Unit Research Project (BURP) experiment,[5] which was searching for foci. Lower maxima obtained from nuclear tests than from 1.2-ton HE bursts in BURP may show results from less scatter for long wavelengths. Alternatively and less comforting, it may reflect our concerted efforts to avoid firing nuclear tests under long range propagation conditions which could cause off-site damage and hazards.

Also interesting is the rapid decay of amplitude with distance in gradient conditions; this was particularly noticeable from Plumbbob data which had an average power-law decay near $p_k^* \sim R^{-2.8}$. This decay is faster than was usually observed from Pacific tests which were also fired in gradient conditions indigenous to tropical oceania. Faster decay at NTS may have been caused by the general land slope toward the southeast observing line, with propagation further refracted up and away from ground by higher temperatures at lower altitudes, as compared to propagation along the horizontal boundary plane of the sea.

The extreme minimum propagation curve in Hardtack can probably be discounted. It was recorded from the Vista event, a 24-ton burst on the surface. This small yield may be uncertain, and the $W_A = 1.6$ W assumption may well be in error. It is generally valid for large nuclear events and generally invalid for high explosives.[6]

With gradient conditions, where there is no acoustic amplitude calculation for propagation into the "silent" zone, a safety envelope can be constructed between the standard

curve at 100, 000 feet and 0. 1 mb at 300, 000 feet. This would allow assurance that no windows would break ($p_k^* \geq 4$ mb) from less than an 8-kiloton yield at 20 miles range, or from less than 10 megatons at 60 miles, from tropospheric propagation of midday or afternoon blasts with light wind speeds at all troposphere altitudes.

The upper envelope of empirical amplitudes shows that windows can be broken by 4-mb recorded amplitudes in Las Vegas by an apparent airburst yield of 9. 9 kilotons, which could be generated by a 1. 9-kiloton burst at 1100 feet above the surface.

Ozonosphere Propagations

Above the tropopause, which is usually near 40, 000 feet MSL, temperatures are nearly constant for a while, then increase with altitude to a maximum near 0°C at about 160, 000 feet in the ozonosphere. Temperatures decrease again above this altitude to another minimum at the base of the ionosphere near 300, 000 feet. The warm ozonosphere layer of relatively high sound speeds serves as a foundation for wind ducting. Wind speeds at these altitudes may exceed 150 mph and cause the sound or wave velocity in downwind directions to exceed the ground level value. This allows ducting and refractive ray bending so that the explosion wave is returned to ground at ranges of from 75 to 150 miles. These upper winds in temperate latitudes blow as seasonal monsoons from west to east in winter and from east to west in summer. In reversing in spring and fall, they become nearly calm for short periods of about two weeks.

Even with calm upper winds, the high temperature layer does serve as a source for wave scattering into the silent zone. A pressure oscillation is always recorded, even at 135 miles upwind, from kiloton or larger nuclear bursts. The result, either in the east or west, is an annual march of amplitudes of quasi-sinusoidal form. Large values occur during the downwind period and small values during the upwind season. The transition may be gradual or truncated, but the scatter in observed transition dates probably obscures the true form in these data, which have been obtained from a small (climatologically speaking) number of events.

Amplitudes from the various tests have been plotted by station in Figures 6 through 13. Bearings and distances to these various stations are listed in Table I. Identification of the graph symbols is given in a legend on Figure 6, St. George data. This figure has the most definitive seasonal data, since this station was the most regularly operated and it is near the right direction and range for maximum amplitude in the seasonal cycling.

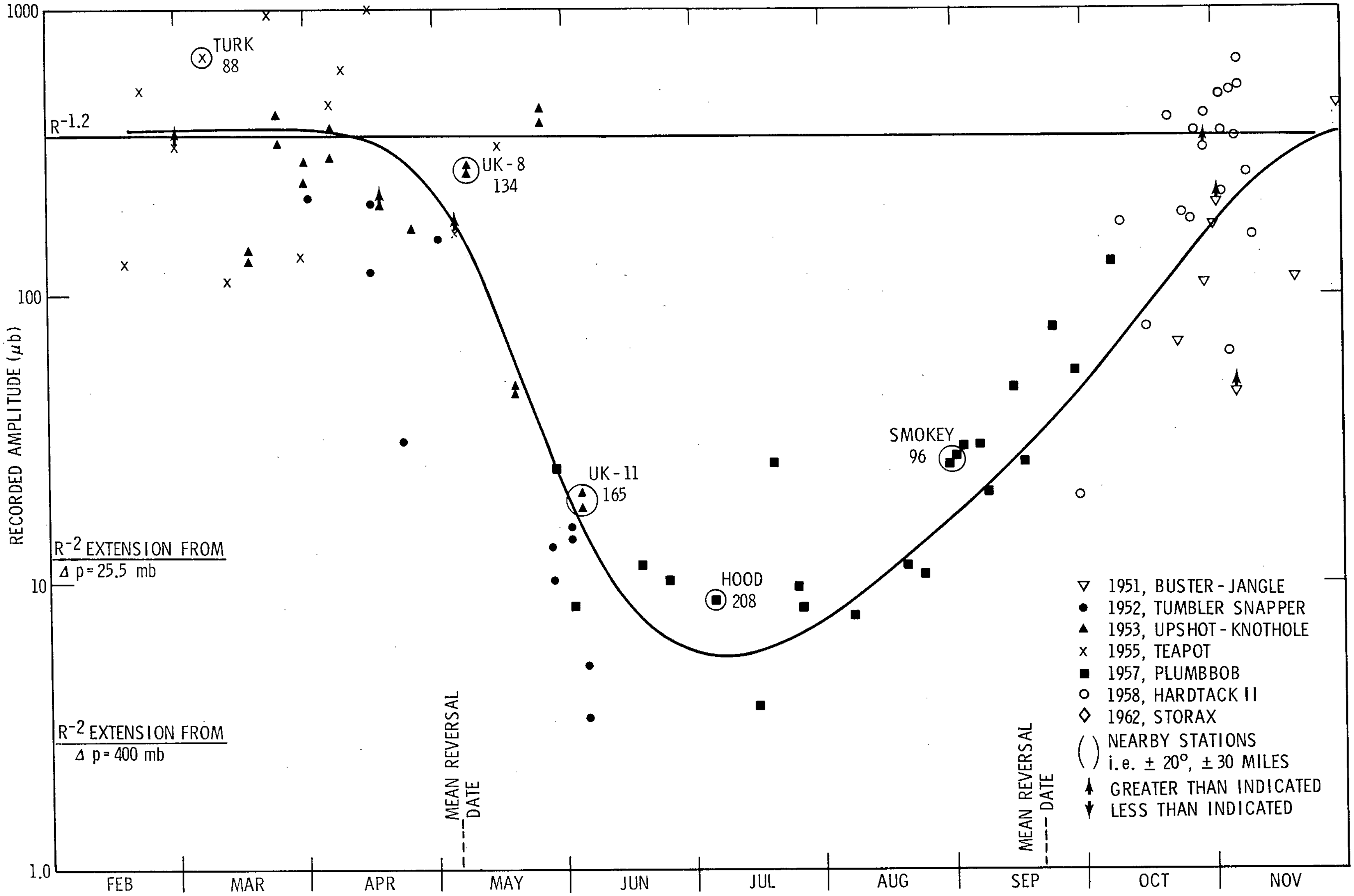

Figure 6. Ozonosphere Signal Amplitudes, St. George, Utah

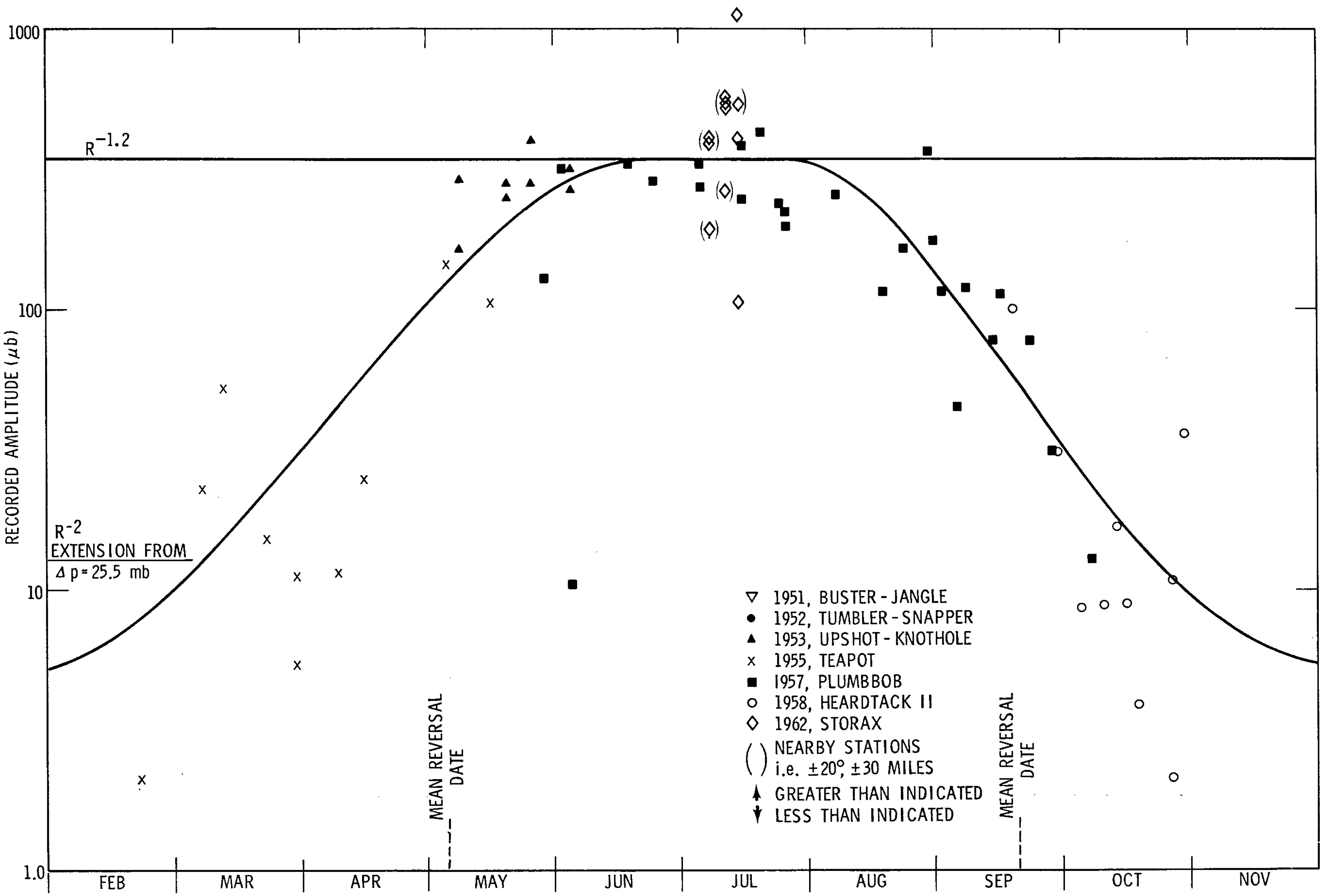

Figure 7. Ozonosphere Signal Amplitudes, Bishop, California

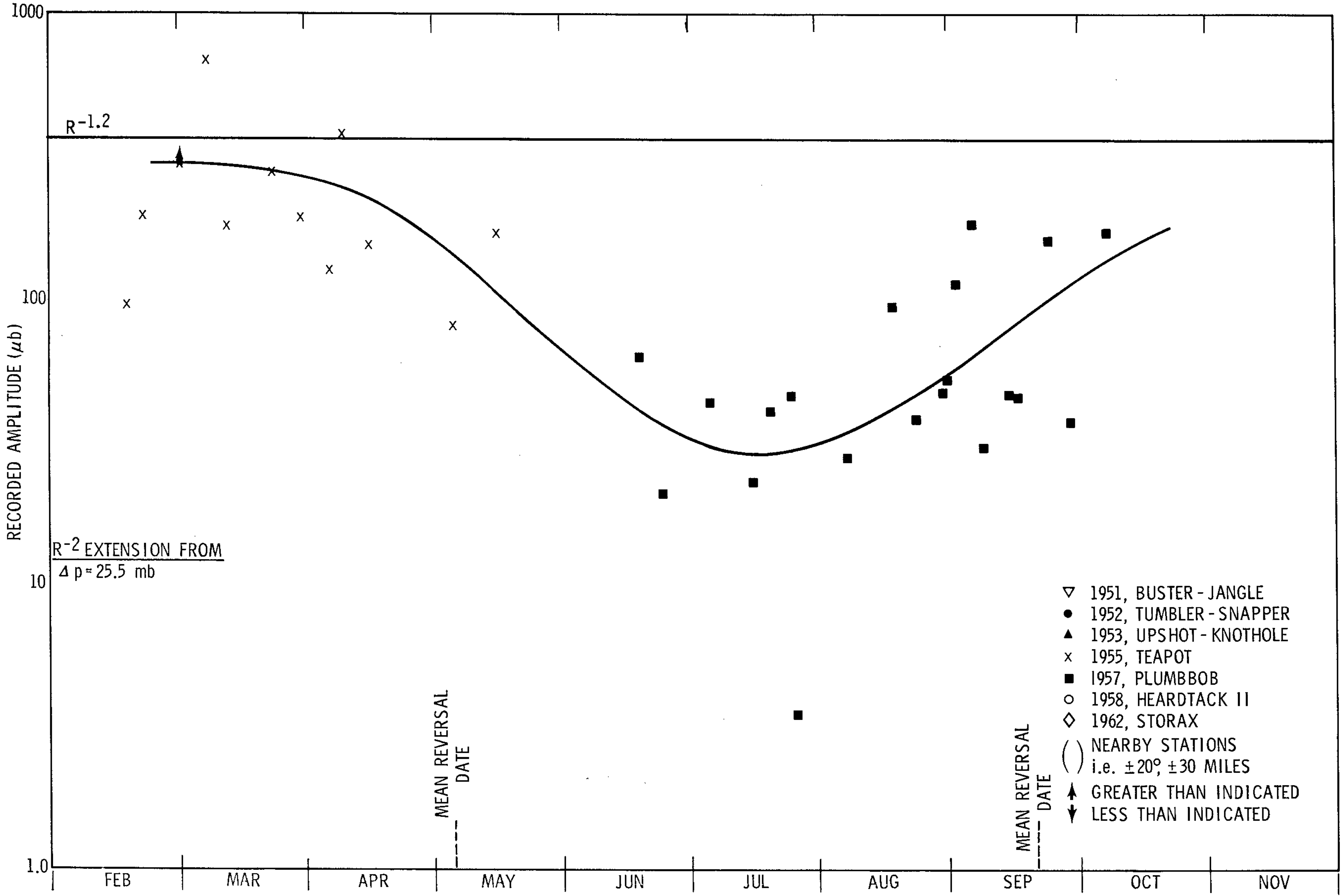

Figure 8. Ozonosphere Signal Amplitudes, Lund, Nevada

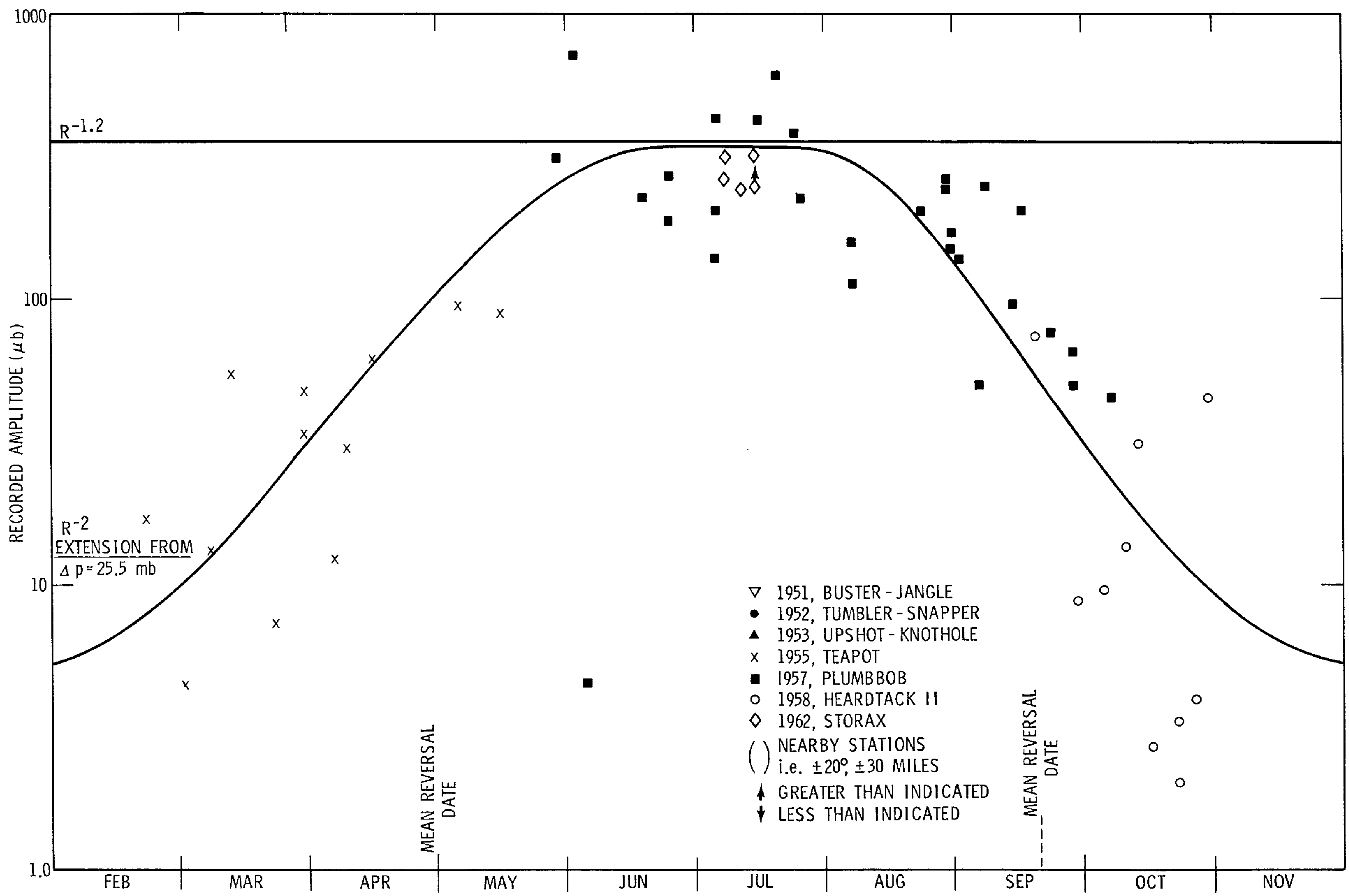

Figure 9. Ozonosphere Signal Amplitudes, China Lake, California

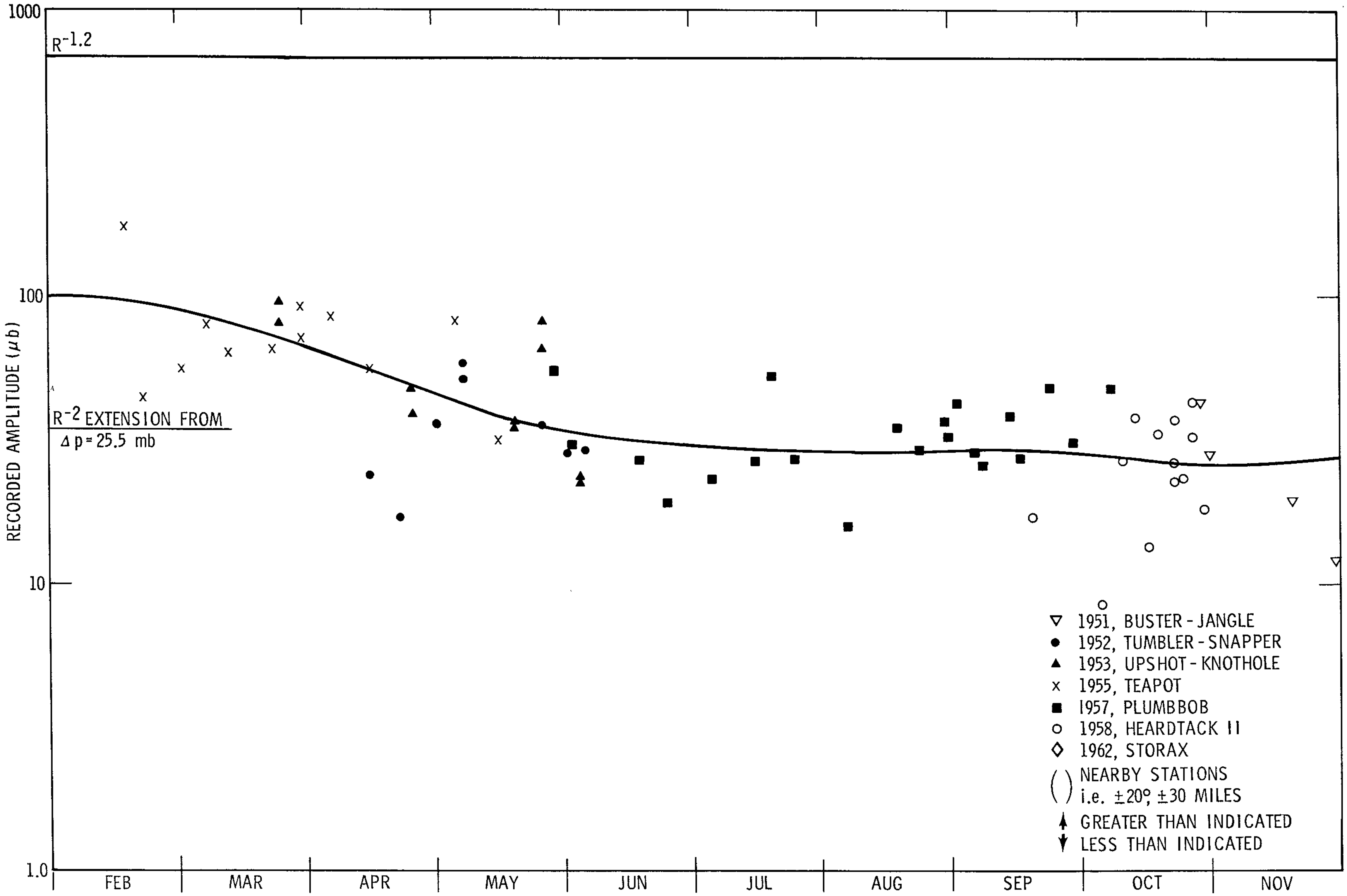

Figure 10. Ozonosphere Signal Amplitudes, Las Vegas, Nevada

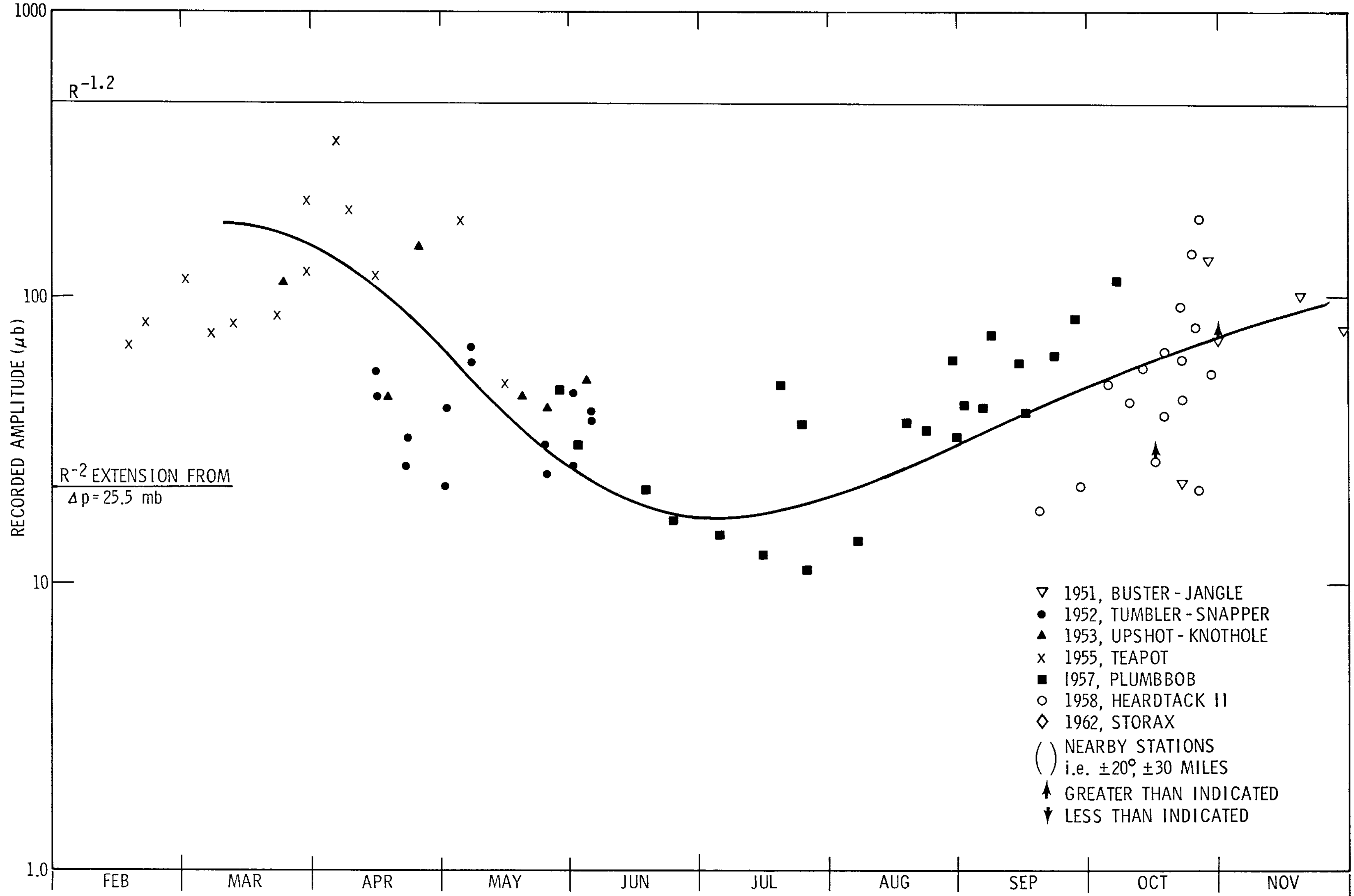

Figure 11. Ozonosphere Signal Amplitudes, Boulder City, Nevada

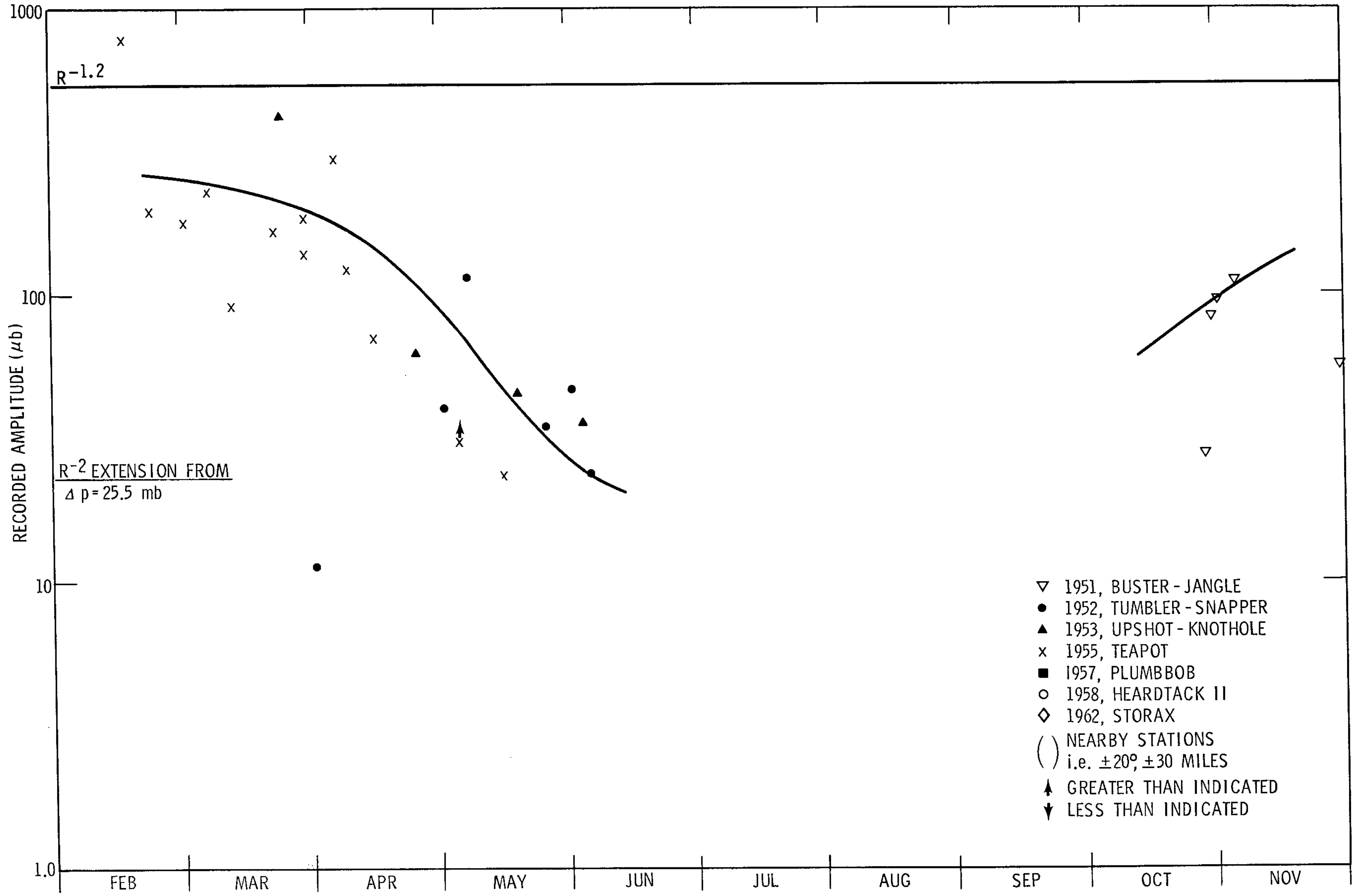

Figure 12. Ozonosphere Signal Amplitudes, Caliente, Nevada

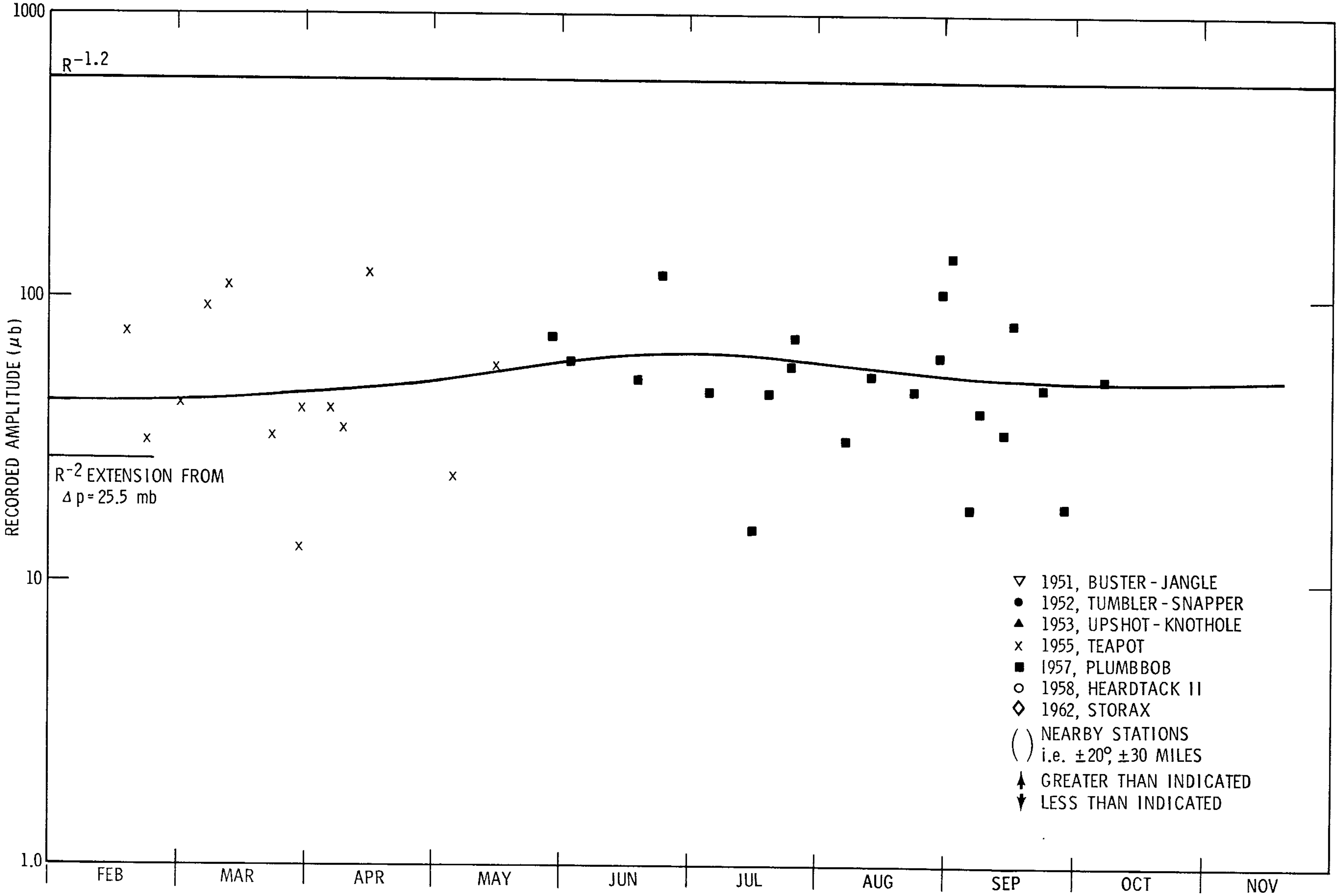

Figure 13. Ozonosphere Signal Amplitudes, Tonopah, Nevada

Five points from the shots with the very largest apparent yields have been identified to show that there seems to be no particular bias from yield-scaling assumptions. The standard amplitude for a 1-kiloton airburst, at 135 miles range, is shown, although specific shots were at individual distances which may be a few miles different. Also, these reference lines on this and successive figures were not adjusted for local pressure altitude. This correction gives a reduction to the standard curve which ranges from 3.6 percent for Las Vegas to 10.9 percent for Lund.

TABLE I

Microbarograph Station Location Vectors*

Station	Bearing (Deg.)	Distance Miles	Distance Kilofeet
Indian Springs, Nevada	142	39	207
Boulder City, Nevada	139	102	536
Caliente, Nevada	64	98	516
St. George, Utah	90	135	714
Lund, Nevada	25	136	717
Tonopah, Nevada	317	90	479
Bishop, California	278	131	692
China Lake, California	223	132	700
Las Vegas, Nevada	142	80	424

*Referenced to Area 7, Yucca Flat

There were no atmospheric nuclear tests in December or January, and few in February and November, so it is impossible to tell whether the winter peak has been missed at St. George. Ray calculations for strongest midwinter rocket winds show the strongest caustics landing at ranges short of St. George, so the annual curve at a fixed distance may well have a flat maximum as shown by these data.

In summer the St. George minimum was well above the value obtained by extrapolating along $p_k^* \sim R^{-2}$ and using a source point at $\Delta p = 400$ mb. These ozonosphere-scattered waves were stronger than waves which were propagated along the ground under gradient conditions, although the latter were frequently detectable above ambient wind noise levels.

It is clear that an average of downwind propagations is about equal to the standard amplitude curve. This appears to contradict previous contentions that the average focus factor for ozonosphere signals was near 2X. Recall, however, that the standard here assumes doubling by ground reflection to give recorded amplitude; whereas, previous comparisons had reference to incident amplitude extrapolations, in keeping with convention for close-in blast measurements. In summary, at St. George one would expect 4 mb recorded amplitudes during the winter phase from 400 kilotons free airburst. This amplitude could come, however, with random focusing from only 32 kilotons FAB, or even 6.3 kiloton burst near 1650 feet HOB.

In the opposite direction toward Bishop, California, the same general pattern was observed, as shown by Figure 7, but with a 6-month phase change. The one extremely high point was actually observed at Deep Springs, about 20 miles east of Bishop, from the Small Boy event in 1962. This amplitude was reduced to correspond to the larger distance at Bishop. The focus factor for this wave was 3.2X.

Propagations in directions quartering to the winds, shown for Lund, Nevada, in Figure 8, are nearly the opposite direction of those for China Lake, California (Figure 9). Both appear to have downwind season averages near standard and similar to the results at St. George and Bishop, which were directly downwind of seasonal mean wind circulations. Lund and China Lake also show a tendency to have larger minimum amplitudes in their upwind seasons, as might be expected for scattered propagations. This filling of the minimum is more pronounced at Lund, bearing N25°E, than at China Lake, bearing S45°W, which is further consistent with the scattering model.

At shorter distances, the southeast line through Las Vegas and Boulder City shows lower amplitudes. At Las Vegas, range 80 miles, there is only slight indication of a seasonal wind influence in phase with ozonosphere cycling (Figure 10). The weak maximum in spring is its only manifestation. As shown in Figure 11, there is more of an annual wave at Boulder City, range 105 miles, but it is not nearly so pronounced as at longer ranges (135 miles) at the four stations described earlier. Boulder City clearly appears to be inside the range of maximum signals. In midwinter months of December and January, they could, however, get larger signals.

Caliente data taken at about 95 miles average range (Figure 12) show stronger amplitudes in winter than do those for Boulder City. Data are sparse for Caliente, but if the appearance is real it may be explained by the observation that very strong winter ozonosphere circulation causes the downwind caustic to land at short range, sometimes

as close as Caliente. The quartering cross-wind component was apparently not strong enough to pull the caustic in to the range of Boulder City during the months of testing.

Finally, Tonopah data in Figure 13 show a pattern similar to Las Vegas, with little apparent seasonal cycling, but slightly larger average amplitudes and some more scatter.

A check was made to see if yield-scaling factor corrections for the observed distance decay[7] reduced the scatter at St. George. It did not noticeably affect the variability. Thus, the more complicated calculation does not appear to improve predictability.

Upwind propagation between Caliente and St. George, and between Las Vegas and Boulder City, appears to decay like R^{-2}, but the coefficients depend on direction across the wind field. China Lake seems to be an exception to the upwind directional effect. Since these upwind waves are of such little importance to damage prediction, this inconsistency will be ignored and an approximate rule of thumb may be used: Recorded upwind ozonosphere signal amplitudes obtain from an extension from the end of IBM Problem M (Δp is multiplied by 2.7 to give recorded amplitude) with R^{-2} slope. This value is shown on all ozonosphere amplitude figures, and in equation form as

$$\text{Upwind Ozonosphere:} \quad \overline{p_k^*} \text{ mb} \approx 6200 \text{ (W kiloton NE)}^{0.4} \text{ (R kilofeet)}^{-2} \qquad (5)$$

One point of interest noted is that the maxima in summer appear to lag two or three weeks behind the summer solstice, conforming with the surface temperature.

The freehand mean curves of Figures 6 through 13 have been assembled in Figure 14, which shows the transition season intersections which correspond to the no-wind condition. No confident explanation is made for the fact that amplitudes are smaller in the fall transition than during the spring reversal. It probably results from higher surface temperatures in late September than in early May, which would tend to reduce the amount of energy reflected back to ground level. It may be only a statistical observation from the small data sample and, in fact, this must be assumed for the present.

This transition period is of considerable importance because it is the time when maximum yields may be detonated without damage at long range in any direction. The distributions of data points from Figures 6 through 9 (nearly equal ranges at 135 miles) have been examined to find out how long an interval may be expected to be suitable for large yield experiments. Figure 15 shows distributions of amplitudes for ±5 days and ±20 days around May 5 and September 20 dates. As this interval is enlarged, scatter is increased to contain more points of both summer and winter propagation regimes.

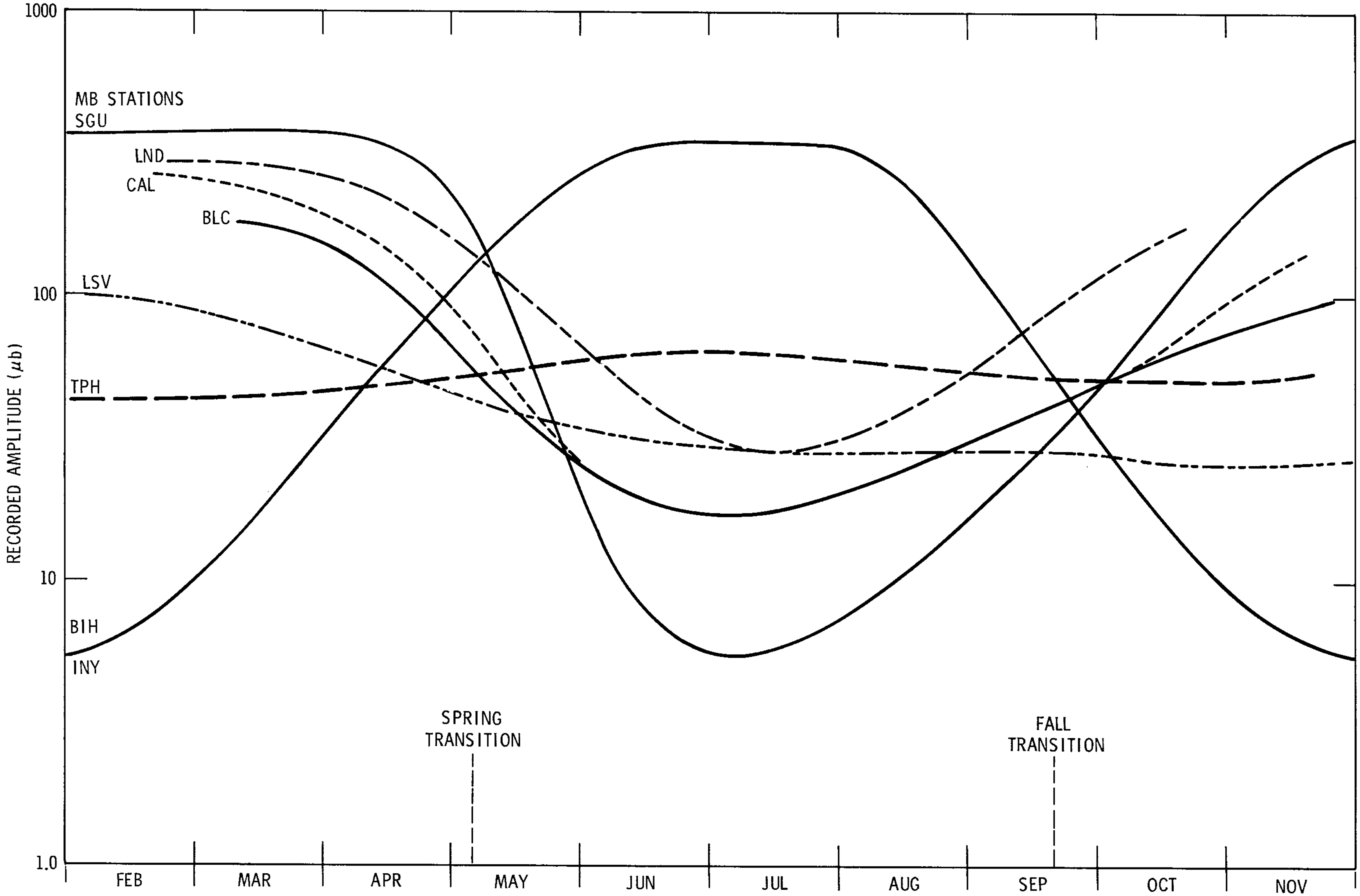

Figure 14. Average Ozonosphere Signal Amplitudes, Seasonal Cycling

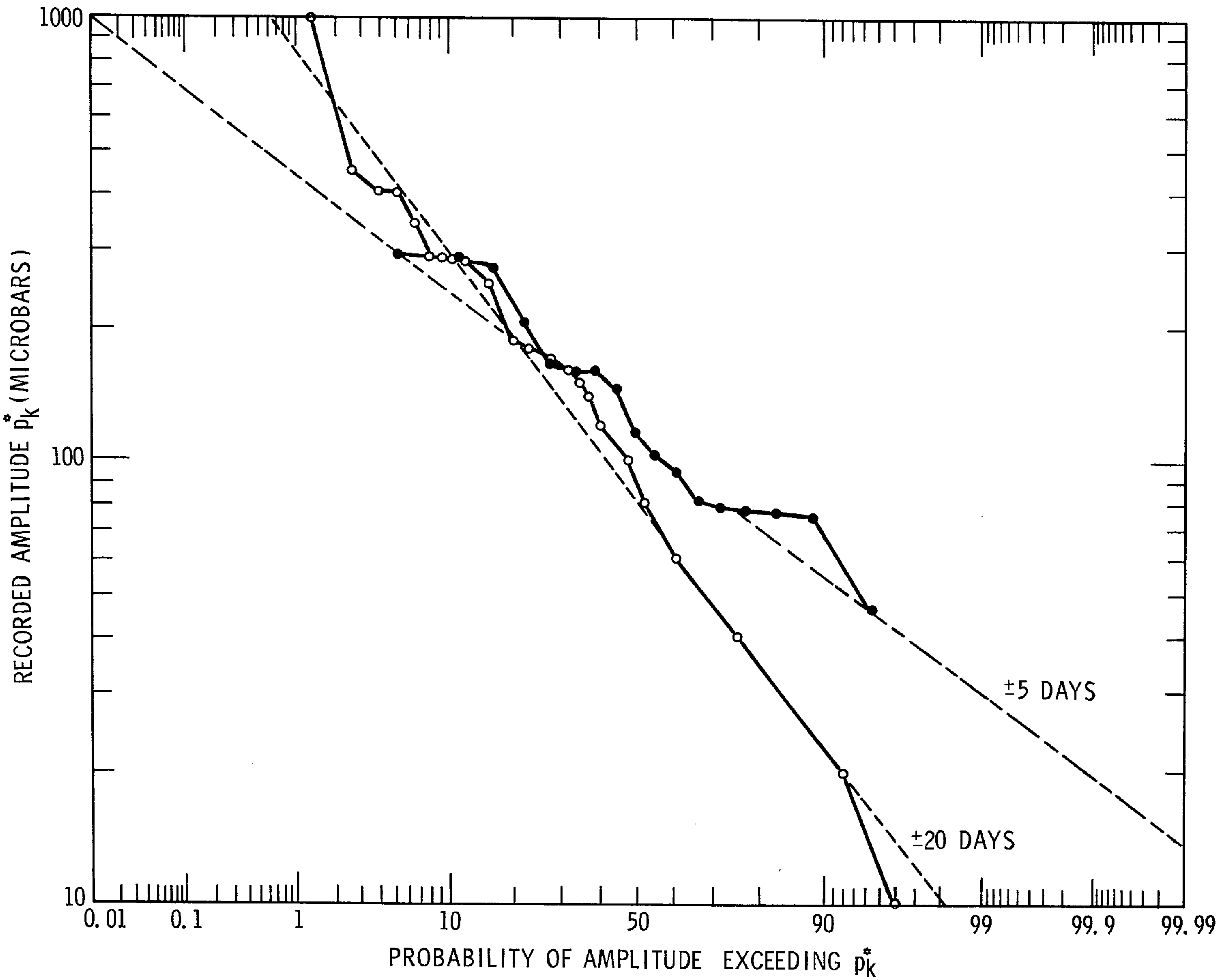

Figure 15. Distribution of Amplitudes in Transition Periods, R = 135 mi., W = 1 kt NE F. A. B.

The average amplitude during these wind transitions is near 0.1 mb at 135 miles, and it is larger than recorded amplitudes at shorter ranges. This hump on the pressure-distance curve indicates that there is a tendency for a sound ring to occur even when the ozonosphere is calm. Even scattered or diffracted waves tend to strike the 135-mile range and skip the shorter ranges.

Calibration Shot Data

There is some concern that data obtained from 1.2-ton HE check shots or calibration shots may bias our interpretations of propagations from underground bursts. Figures 16 and 17 show amplitude versus date plots of some of these data from recordings made at St. George. Check shots were used 1 and 2 hours prior to atmospheric nuclear tests and were fired on the ground surface. Each was made up of four 600-pound depth charges, surplus from World War II. The equivalent yield for HE surface bursts is assumed to be 0.6 W; thus, $W_A = 1.44 \times 10^{-3}$ kilotons NE FAB, and the "standard" line in Figure 16 reflects this assumption. Later, explosives were mounted at 15 feet above ground to enhance the apparent yield, give better repeatability, and minimize cratering. These calibration shots are assumed to yield $W_A = 5.04 \times 10^{-3}$ kilotons NE FAB, to give the standard line in Figure 17. Note the changed date scale in Figure 17, used to accommodate the December and January ozonosphere data which have been accumulated in more recent years.

From these figures it is not clear that these waves suffered any significant average attênuation because of their higher frequency. A calculated downwind season average would probably give less than standard amplitude, but with the large scatter the probable error in the mean would also be relatively large. A further point is that the microbarograph recorders have a nonlinear attenuator set to damp high-frequency, low-amplitude signals so that many of the small reported data points may have really been over-attenuated.

Distributions of Downwind Ozonosphere Amplitudes

Recordings at St. George, made during the downwind months of November through March and analyzed in terms of focus factor statistics, are shown in Figure 18. Freehand

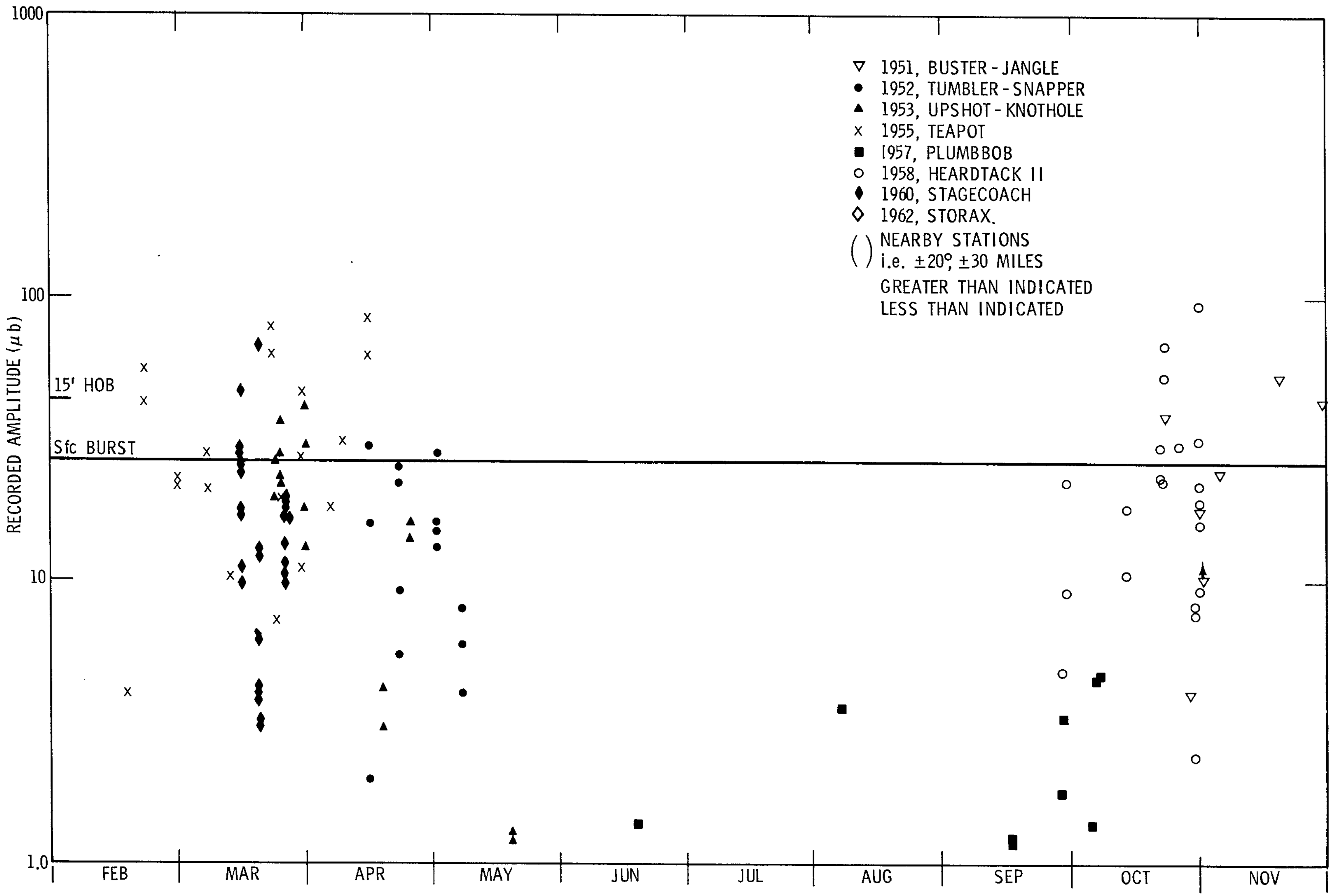

Figure 16. Check Shot Amplitudes, Ozonosphere Signals, St. George, Utah, for 1.2-ton HE Surface Bursts (Before 1960)

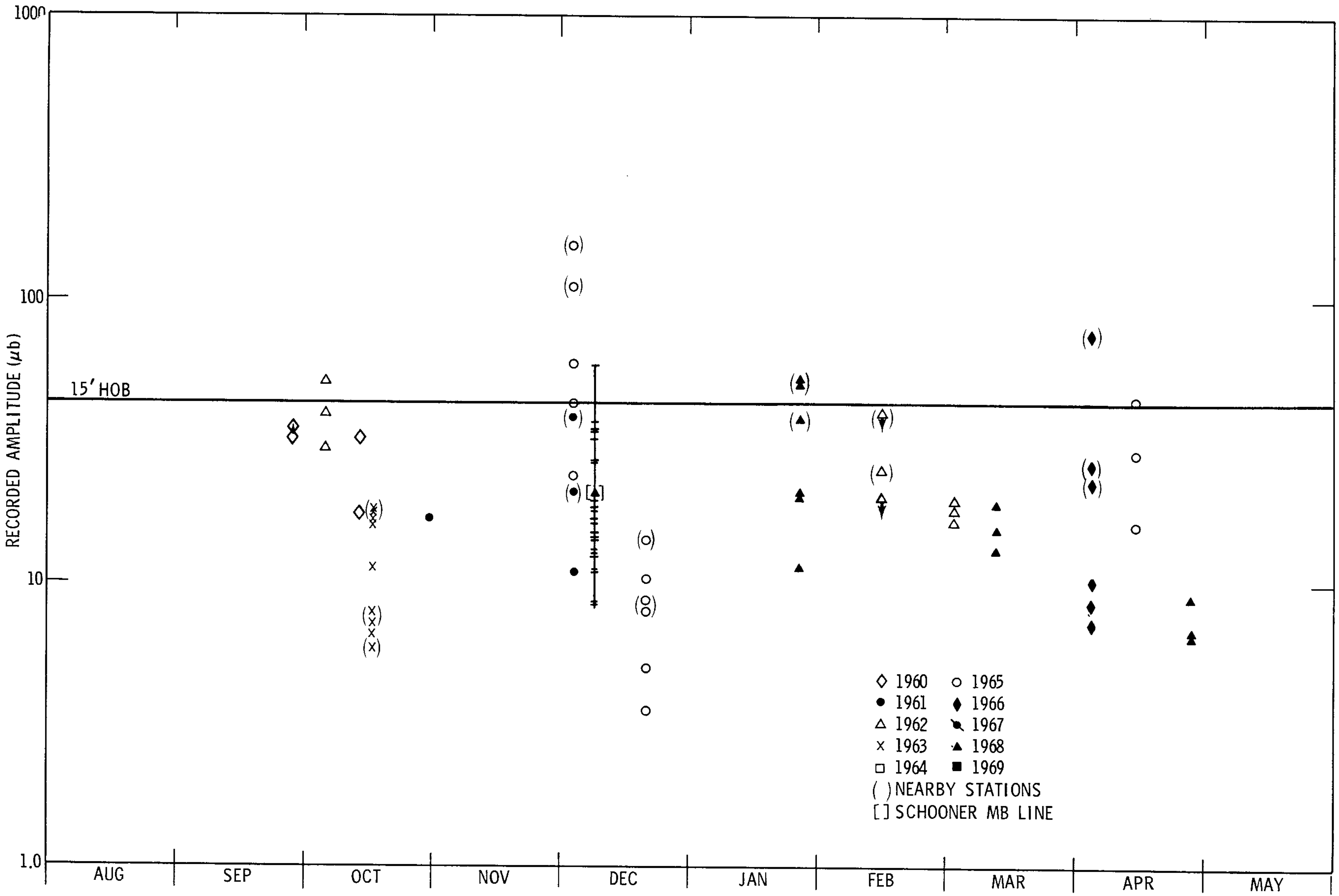

Figure 17. Check Shot Amplitudes, Ozonosphere Signals, St. George, Utah, for 1.2-ton HE at 15-Ft. HOB (1960 to Present)

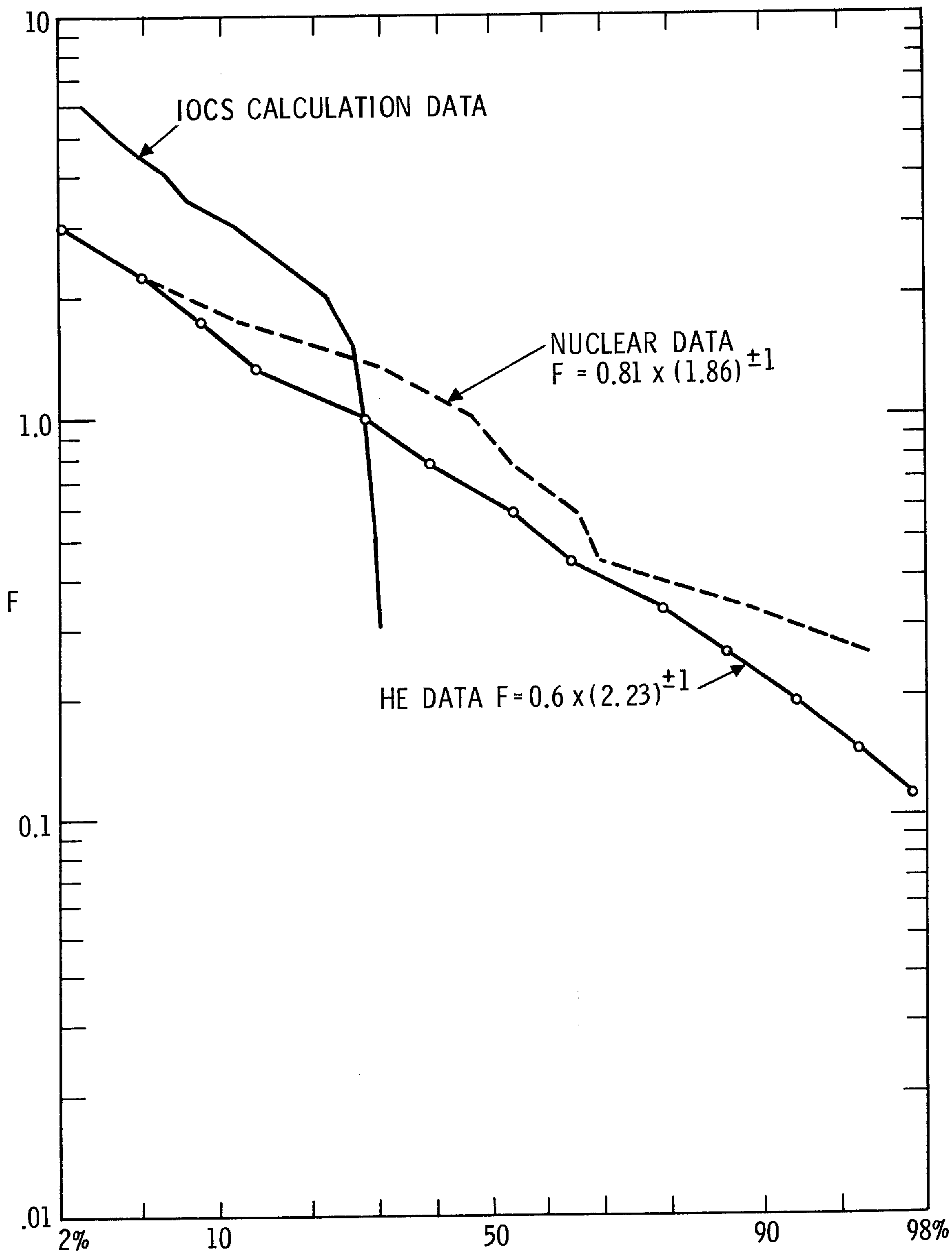

Figure 18. Distribution of Atmospheric Focus Factors, St. George, Utah, Winter Data (November - March)

curves of the separate distributions for NE and HE data give log-normal distribution functions

$$\text{NE:}\quad F = 0.81 \times (1.86)^{\pm 1} \quad ,$$
$$\text{HE:}\quad F = 0.6 \times (2.23)^{\pm 1} \quad .$$

The distribution midpoint for HE data is at $F<1.0$, but it seems premature to adopt this without more detailed case studies. The Prairie Flat experiment[8] showed that, on the average, there was no significant difference between the attenuations of the 1.2-ton HE calibration shots and the 500-ton HE surface burst.

At any rate, the nuclear data show F = 1 very near the 50 percent line, particularly when the distribution for the data-half with large amplitudes is extended. Most important is the appearance of less scatter to the nuclear data, although the reduction of scatter is not as marked as that found by comparison of different yields of HE at Prairie Flat.

A comparison with a distribution of calculated focus factors is also shown. Ray trace calculations for 415 rocket soundings at Battery MacKenzie, Canal Zone, were used for a source of focus factors at R = 700,000 feet on days when some ducting was calculated. Of these, the calculated rays landed short of 700,000 feet on 275 occasions and long on 17 occasions, and a wave was found to strike this range on 123 occasions. The distribution of calculated F values is shown on Figure 18. Quite clearly, the real atmosphere attenuates the strong foci and fills the calculated silent zones with waves. There may be a significant difference between downwind propagations from NTS and from Panama, but it should depend only on the mere presence of adequate wind-aloft speeds to cause ducting. There is almost twice as much energy flux calculated by numerical integration of F^2dP, where P is probability, as was observed by the NTS distribution. The most likely repository for this excess of calculated ducted energy is in the multiplicity of wave cycles recorded by microbarographs.. The acoustic ray calculation often shows only one wave cycle and sometimes two, rarely three or more. In reality, as described in the Prairie Flat analysis,[8] the upper wind structure has many reflecting layers which are not observable by present rocket sounding techniques. These strata tend to break up the wave into more fronts which spread over the sound ring and extend its boundaries. The result gives the observed attenuation, similar to the effect of turbulence. Most significiantly, it reduces the expectation of very large amplitudes and strong foci which result from simple acoustic ray calculation, but for the present it makes deterministic prediction for a specific event much more uncertain.

Tropospheric Propagation Climatology

Since experience with strong tropospheric ducting has been truncated by our attempts to prevent damage to outlying communities, it may be questioned that we call this observed collection of nuclear blast amplitudes a climatology. On the other hand, since the dominant concern was with jet-stream ducting, low altitude ducting under temperature and wind shear inversions was largely neglected so these results may be typical. This only affected on-site damages or, at worst, damages to the "controlled" population at Indian Springs. Since it may sometimes be useful in predicting inversion propagations, the amplitude distribution at Indian Springs is shown in Figure 19. Reference back to Figures 2 through 5 shows that large amplitudes on-site were common, but after travel over the mountains to Indian Springs the average focus factor had dropped from above 1 to near 1/2. Scatter was great, however, with $\pm 1\sigma$ ranging from near 0.1 to 2.0 mb.

No attempt has been made to analyze on-site data distributions because the short distances would require a distance normalization calculation in addition to the yield normalization.

Conclusions

There are three atmospheric sound ducts for significant airblast propagation off-site from NTS explosive tests. Strong propagation under inversions is usually restricted to the test basins of Yucca Flat or Frenchman's Flat by the surrounding mountains. These amplitudes decay rapidly with distance to off-site communities.

Strong winds in the troposphere can duct strong waves off-site and cause damages at Indian Springs and Las Vegas. Jet-stream ducting has given as much as 5X magnification in recorded nuclear blast waves, referenced to standard propagation in a homogeneous, calm atmosphere with spherical wave expansion and no refraction.

Ozonosphere ducting, from altitudes near 150,000 feet MSL, goes in seasonal directions: east in winter, west in summer. Maximum amplitudes usually strike at ranges near 135 miles but they may scatter from 75 miles to 150 miles. Maximum observed focusing from nuclear events is near 3X, and average downwind amplitudes fall near the standard curve. Upwind propagations are scattered into areas where there are no calculated acoustic ray penetrations, and amplitudes at 135 miles show an average 0.016X reduction below standard. During the short semi-annual periods of near-calm conditions

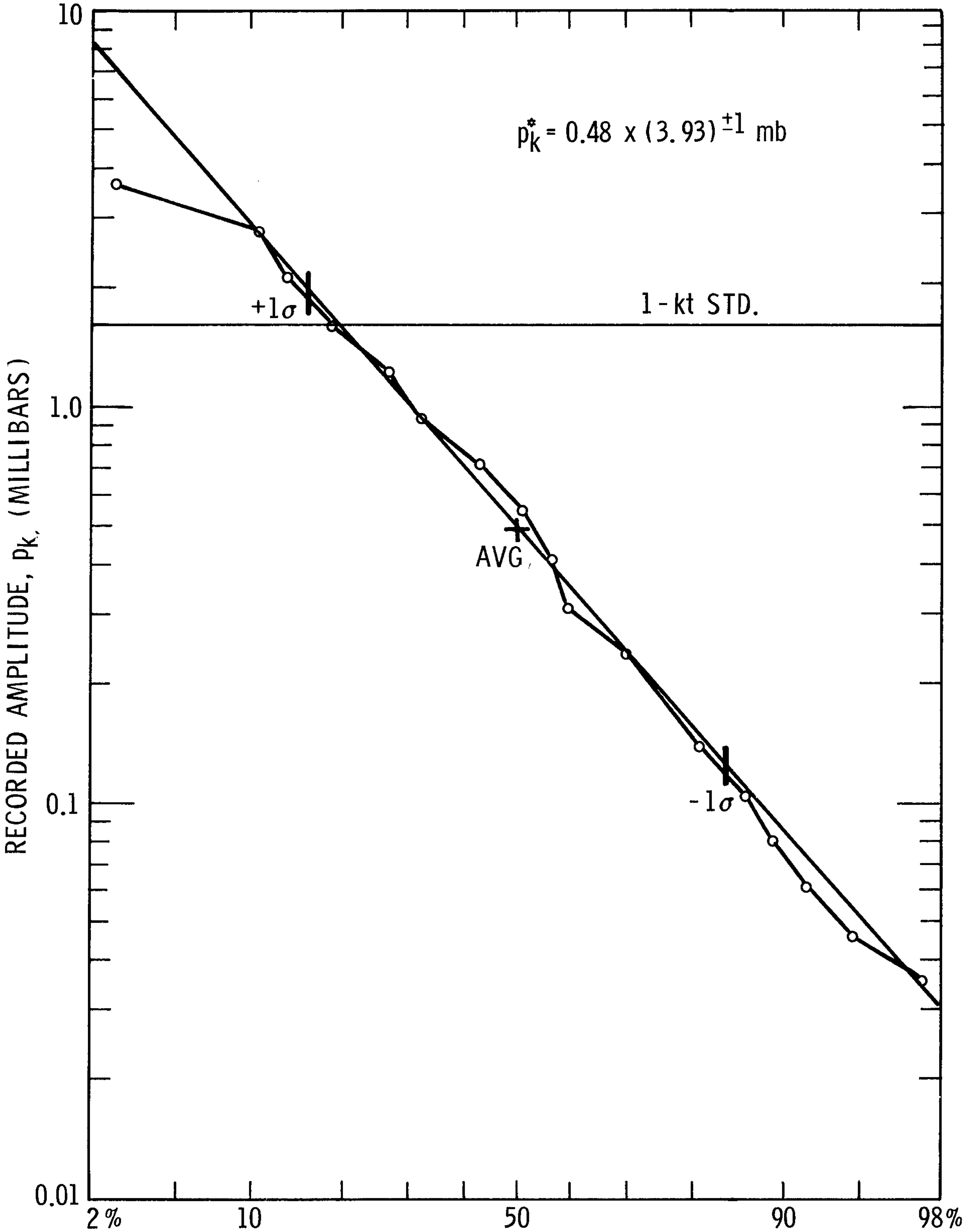

Figure 19. Troposphere Signals Scaled to 1-kt Free-Airburst Recorded Peak-to-Peak Amplitudes, Indian Springs (38 Miles)

at high altitudes, the average reduction is 0.28X in all directions. This occurs as seasonal wind directions reverse in early May and late September, but may happen early or late by as much as a month in a specific year.

Check shots and calibration shots, 1.2-ton HE bursts, give nearly the same amplitude propagation patterns as nuclear bursts and they do not appear to be specially attenuated because of their higher frequency components. Waves from these small yields have more scatter and non-repeatability in amplitude because their higher frequencies interact more with atmospheric turbulence and small-scale layer structures.

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APPENDIX

MAXIMUM SIGNAL AMPLITUDES FROM MICROBAROGRAPH RECORDS OF ATMOSPHERIC NUCLEAR TESTS

APPENDIX

MAXIMUM SIGNAL AMPLITUDES FROM MICROBAROGRAPH RECORDS OF ATMOSPHERIC NUCLEAR TESTS

The following tables show, for each Nevada nuclear test in Operation Tumbler-Snapper through Operation Hardtack-II, maximum peak-to-peak recorded airblast amplitudes which were propagated to each microbarograph via each of the three major atmospheric channels. The quality of these data generally improved with time as we developed our predictive and measuring capabilities. There are inconsistencies which may have resulted from any of several factors. Original records were not re-read at this time in hope of finding corrections. Past efforts to check specific questionable points have usually shown them to be impossible to adjust because of partial failures either by the equipment or the operators. Hopefully, in this large sample of data, the overall effect of these wild points is negligible.

For example, in the first table, for Tumbler-Snapper Event No. 1, the two sensors at St. George, C (close) and F (far), show a factor of four difference in amplitude for both troposphere and ozonosphere signals. On the check shots, however, there was not this disagreement, so it does not appear that set calibration was in error. Instead, it is likely that the operator failed to make the correct range switch setting or there was faulty wiring on one set for the full-scale test recording, but there is no way to establish which set was correct. Check shot amplitudes could be projected for calculations about which was correct but this would assume near-constant atmosphere propagation for 1 or 2 hours. That assumption could also be subject to considerable error.

Distance figures are also subject to some error, but they are probably not significant in this context. Some early station survey data were classified at their issuance and have since been destroyed. Only approximate locations were kept. This should seldom cause even a 1-mile error. Very accurate surveys (to ±0.1 foot) were made for many stations during 1954, for sound-ranging calculations, so that distances are available to much greater precision than these tables show.

There has been no attempt to be consistent with significant figures in reporting amplitudes. Depending on ambient or electrical noise levels, calibration procedures, etc., original data tabulations reflected varying confidence, so one-, two- and three-significant figures are used indiscriminantly.

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Able DATE 10/22/51 TIME 1400 Z

YIELD <0.1 kt BURST HEIGHT 100 ft. LOCATION A-3

APPARENT BLAST YIELD , W_a = >0.238 kt, $W_a^{0.4}$ >0.562

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	141	405	86		
Henderson	139	464	47	10.7	
Boulder City	138	523	51	12.8	
Caliente	065	481		(1)	
St. George	089	713		38.5	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Baker DATE 10/28/51 TIME 1520 Z

YIELD 3.5 kt BURST HEIGHT 1118 ft. LOCATION A-3

APPARENT BLAST YIELD, W_a = 16.9 kt, $W_a^{0.4}$ 3.09

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	150	197	520		
Las Vegas	141	405	9.5	134	
Henderson	139	464	5.5	>180	
Boulder City	138	523		415	
Caliente	065	481	15.5	85	
St. George	089	713		345	
Beatty	257	220	65		
Goldfield	304	424	930		

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Charlie DATE 10/30/51 TIME 1500 Z

YIELD 14.0 kt BURST HEIGHT 1132 ft. LOCATION A-3

APPARENT BLAST YIELD, W_a = 48.0 kt, $W_a^{0.4}$ 4.71

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	150	197	850		
Las Vegas	141	405	4.4	134	
Henderson	139	464		330	
Boulder City	138	523		>340	
Caliente	065	481	37	390	
St. George	089	713		840	
Beatty	257	220	>630		
Goldfield	304	424	310		

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Dog DATE 11/ 1 /51 TIME 1530 Z

YIELD 21 kt BURST HEIGHT 1417 ft. LOCATION A-3

APPARENT BLAST YIELD , W_a = 77.4 kt, $W_a^{0.4}$ 5.69

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	150	197	>770		
Las Vegas	141	405	>1080 (2)		
Henderson	139	464	>910		
Boulder City	138	523	>1040		
Caliente	065	481	470	545	
St. George	089	713	705	>1200	
Beatty	257	220	295		
Goldfield	304	424	(1)	(1)	

(1) No signal/noise.
(2) U. S. Weather Bureau, McCarran Field, barograph showed 2. 4 MB amplitude but this equipment is heavily damped.

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Easy DATE 11/5 /51 TIME 1630 Z

YIELD 31.4 kt BURST HEIGHT 1314 ft. LOCATION A-3

APPARENT BLAST YIELD , W_a = ______ kt, $W_a^{0.4}$ ______

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	150	197	>800		
Las Vegas	141	405	>770		
Henderson	139	464	>900		
Boulder City	138	523	225		
Caliente	065	481	>900	710	
St. George	089	713	175	>295	
Beatty	257	220	>400		
Goldfield	304	424	950		

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Sugar DATE 11/19/51 TIME 1700 Z

YIELD 1.2 kt BURST HEIGHT 4 ft. LOCATION A-10

APPARENT BLAST YIELD, W_a = 1.92 kt, $W_a^{0.4}$ 1.298

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	153	232	53		
Las Vegas	144	438		25	
Henderson	141	496		93	
Boulder City	140	555		130	
Caliente	070	472	625		
St. George	092	718	163	152	
Beatty	247	225	>82		
Goldfield	300	399	(1)	(1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Buster-Jangle EVENT Uncle DATE 11/29/51 TIME 2000 Z

YIELD 1.2 kt BURST HEIGHT -17 ft. LOCATION A-10

APPARENT BLAST YIELD, W_a = 1.92 (est'd) kt, $W_a^{0.4}$ 1.298 (est'd)

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	153	232	130		
Las Vegas	144	438	29.5	15.4	
Henderson	141	496	40	130	
Boulder City	140	555	4.2	102	
Caliente	070	472	142	71	
St. George	092	718	102	610	
Beatty	247	225	25.5		
Goldfield	300	399		33	

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-1 DATE 4/1/52 TIME 1700 Z

YIELD 1.1 kt BURST HEIGHT 793 ft. LOCATION FF

APPARENT BLAST YIELD, W_a = 5.45 kt, $W_a^{0.4}$ 1.97

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas C	137	332	280		
Las Vegas F	137	336	300		
Henderson	134	399	65		
Boulder City	134	445	85		
Caliente	055	507		21	
St. George C	082	692	50	98	
St. George F	082	696	210	440 (1)	
Goldfield	310	472		4	

(1) Discrepancy between sensors was not significant on check shots; suspect one range setting was made incorrectly.

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-2 DATE 4 /15 /52 TIME 1730 Z

YIELD 1.2 kt BURST HEIGHT 1109 ft. LOCATION A-3

APPARENT BLAST YIELD, W_a = 5.55 kt, $W_a^{0.4}$ 1.99

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	141	404	31	47	
Henderson	139	464	74		
Boulder City	138	523		105	
St. George C	089	712		250	
St. George F	089	716		420	
Albuquerque	110	2920		(1)	

(1) Loud bang distinctly heard by many residents, no MB recording.

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-3 DATE 4/22/52 TIME 1730 Z

YIELD 30.7 kt BURST HEIGHT 3447 ft. LOCATION A-3

APPARENT BLAST YIELD, W_a = 133 kt, $W_a^{0.4}$ 7.07

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	141	404	740 (1)	120	
Henderson	139	464	800	160	
Boulder City C	138	523	520	180	
Boulder City F	138	528	600	220	
Caliente	065	481	480		
St. George	089	713		230	
Goldfield	304	424	1005 (1)		

(1) Some confusion on timing; these signals were originally recorded as ozonosphere propagations.

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-4 DATE 5/1 /52 TIME 1630 Z

YIELD 19.2 kt BURST HEIGHT 1040 ft. LOCATION A-3

APPARENT BLAST YIELD, $W_a =$ 57.2 kt, $W_a^{0.4}$ 5.04

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	141	404	305	180	
Henderson	139	464	210		
Boulder City C	138	523	100	110	
Boulder City F	138	528	180	210 (2)	
Caliente	065	481	230	205	
St. George C	089	712	100	115	
St. George F	089	716	103	800 (1)	
Goldfield	304	424	280		

(1) Very doubtful report.
(2) Suspect one set out of calibration.

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-5 DATE 5 / 7 /52 TIME 1215 Z

YIELD 12.0 kt BURST HEIGHT 300 ft. LOCATION T-1

APPARENT BLAST YIELD , W_a = 24.2 kt, $W_a^{0.4}$ 3.58

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas C	141	435		190	
Las Vegas F	141	440		210	
Boulder City C	137	539		210	
Boulder City F	137	547		240	
Caliente	067	505	>950	410	
St. George C	090	730	650		
St. George F	090	733	560		
Goldfield	304	405		115	

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-6 DATE 5/25/52 TIME 1200 Z

YIELD 11.1 kt BURST HEIGHT 300 ft. LOCATION T-4

APPARENT BLAST YIELD, W_a = 22.5 kt, $W_a^{0.4}$ 3.48

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	142	447		130	
Henderson	139	490	45	80	
Boulder City C	138	551		85	
Boulder City F	138	558		170	
Caliente	068	498		120	
St. George C	091	733	40		47
St. George F	091	737	45		37
Goldfield	306	393	140		

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-7 DATE 6 / 1 /52 TIME 1155Z

YIELD 14.6 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD, W_a = 29.4 kt, $W_a^{0.4}$ 3.86

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	143	419	260	110	
Henderson	139	464	52	90	
Boulder City C	139	522		100	
Boulder City F	139	529		180	
Caliente	065	484		180	
St. George C	089	709		55	110
St. George F	089	714		60	140
Goldfield	304	424		105	
Los Angeles	212	1220		(1)	

(1) Heard, record for Pasadena not available.

MICROBAROGRAPH DATA SUMMARY

OPERATION Tumbler-Snapper EVENT TS-8 DATE 6 / 5 /52 TIME 1155 Z

YIELD 13.9 kt BURST HEIGHT 300 ft. LOCATION T-2

APPARENT BLAST YIELD , W_a = 28.0 kt, $W_a^{0.4}$ 3.79

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Las Vegas	143	462		110	
Boulder City C	139	565		140	
Boulder City F	139	572		160	
Caliente	070	497	30	90	
St. George C	092	737		13	44
St. George F	092	741		20	100
Goldfield	300	411	460	87	
Los Angeles	212	1220		88	

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Annie DATE 3 /17/53 TIME 1320 Z

YIELD 16.2 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD , W_a = 32.4 kt, $W_a^{0.4}$ 4.02

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Mercury	177	141.5	5100		
Indian Springs F	152	193.2	3102		
Las Vegas C	137	411	360		
Las Vegas F	137	415	390		
St. George C	089	709	585		
St. George F	089	714	525		
Goldfield C	304	425		210	
Pasadena	212	1221		130	80

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Nancy DATE 3/24/53 TIME 1310 Z

YIELD 24.4 kt BURST HEIGHT 300 ft. LOCATION T-4

APPARENT BLAST YIELD, W_a = 47.9 kt, $W_a^{0.4}$ 4.70

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	167	59.9	9600		
FFT	167	109.0	1300		
Mercury	169	161.9	325		
Indian Springs C	149	216	280		
Las Vegas C	142	439		380	
Las Vegas F	142	444		460	
Boulder City	138	550.7		526	
Caliente	068	498.4		2000	
St. George C	091	732.7		2000	
St. George F	091	737		1600	
Cedar City C	077	906	120	1200	
Cedar City F	077	911.6	120	1320	
Goldfield C	304	394	55	100	
Goldfield F	304	396	70	120	
Albuquerque	110	2920		103	
Pasadena	212	1229		56	90

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Ruth DATE 3/31/53 TIME 1300 Z

YIELD 0.2 kt BURST HEIGHT 300 ft. LOCATION A-7.5

APPARENT BLAST YIELD, W_a = 0.882 kt, $W_a^{0.4}$ 0.73

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	191	54.7	8400		
XMF-1	185	68.9	4500		
XMF-2	185	68.9	4500		
FFT	179	101.8	3200		
SCU	178	133	3900		
Mercury	177	154.9	2160		
Indian Springs C	154	205.0	690		
Las Vegas C	144	429.0	132		
Las Vegas F	144	435	110		
Boulder City	140	531.7	22.6		
Caliente	067	477.7	123.0		
St. George C	090	708.6	20	220	
St. George F	090	712.4		260	
Cedar City C	076	884	7.8	97.2	
Cedar City F	076	889.2		84	
Goldfield C	304	417		10.2	
Albuquerque	110	2920		29.3	
Pasadena	212	1229		22.0	20.0

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Dixie DATE 4 / 6 / 53 TIME 1530 Z

YIELD 10.9 kt BURST HEIGHT 6020 ft. LOCATION A-7.3

APPARENT BLAST YIELD, W_a = 10.9 kt, $W_a^{0.4}$ 2.60

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	191	55.5	10168		
XFM	185	69.5	3970		
FFT	179	101.8	3683		
SCU	178	133	4078		
Mercury	177	154.9	2280		
HWY	177	176	1880		
Indian Springs C	154	200.5	>3200		
Indian Springs F	154	205.0	>3200		
Las Vegas C	144	429.0	>2320		
Las Vegas F	144	425	2480		
Boulder City	140	531.7	2320		
Caliente	067	477.7	> 878		
St. George C	090	708.6	1000		
St. George F	090	712.4	780		
Cedar City C	076	884	336	732	
Cedar City F	076	889.2	312	636	
Goldfield C	304	417		328	
Goldfield F	304	421		400	
Pasadena	212	1229	46.5	96.0	

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Ray DATE 4/11/53 TIME 1245 Z

YIELD 0.2 kt BURST HEIGHT 100 ft. LOCATION T-4A

APPARENT BLAST YIELD, W_a = 0.424 kt, $W_a^{0.4}$ 0.709

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	167	55.9	5300		
XFM	172	77.3	4800		
SCU	165	142	3300		
Mercury	169	161.9	2080		
Indian Springs C	149	220.2	2663		
Indian Springs F	149	224.9	2250		
Las Vegas C	142	446.9	420		
Las Vegas F	142	452	476		
Henderson	140	524	620		
Boulder City	138	558	200		

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Badger DATE 4/18/53 TIME 1235 Z

YIELD 23.0 kt BURST HEIGHT 300 ft. LOCATION T-2

APPARENT BLAST YIELD, W_a = 45.8 kt, $W_a^{0.4}$ 4.61

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
XFM	166	92.8	8160		
FFT	166	125.2	6740		
SCU	167	158.5	4500		
Mercury	168	178.1	2840		
HWY	168	200.6	2400		
Indian Springs C	150	231.4	3570		
Indian Springs F	150	235.9	3400		
Las Vegas C	143	456	330		
Las Vegas F	143	461.9	360		
Boulder City	139	572.5	467	204	
Caliente	070	496.7	>960		
St. George C	092	737.0	>960	540	
St. George F	092	741	>960	600	
Cedar City C	078	908	>320	>320	72
Cedar City F	078	911.9	>320	>320	168
Goldfield C	304	378	30	255	36
Goldfield F	304	382		>215	
Albuquerque	110	2920	8.1	18.9	
Pasadena	212	1232		117.0	56.4

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Simon DATE 4 /25 /53 TIME 1230 Z

YIELD 42.7 kt BURST HEIGHT 300 ft. LOCATION T-1

APPARENT BLAST YIELD , W_a = 83.3 kt, $W_a^{0.4}$ 5.85

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
XMF	163	61.4	11100		
FFT	163	94.2	4760		
SCU	165	125.2	3290		
Mercury	167	146.6	1960		
Indian Springs C	146	202.5	> 900		
Indian Springs F	146	207.0	> 780		
Las Vegas C	141	431	283	259	
Las Vegas F	141	434.9	232	165	
Boulder City	137	546.7		870	
Caliente	067	504.5	585	362	
St. George C	090	733.0		1000	
Cedar City C	076	912	90	1440	180
Cedar City F	076	915.6	94	1680	210
Goldfield F	304	405	103.2	190	
Beatty	254	191	408		
Albuquerque	110	2920		180	
Pasadena	212	1210	10	150	

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Encore DATE 5/8/53 TIME 1530 Z

YIELD 26.5 kt BURST HEIGHT 2425 ft. LOCATION FF

APPARENT BLAST YIELD, W_a = 133.8 kt, $W_a^{0.4}$ 7.07

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	323	61.7	8475		
Mercury	200	53.3	20600 (1)		
Indian Springs C	141	97.5	4300		
Indian Springs F	141	102.0	4460		
Las Vegas C	137	327	648		
Las Vegas F	137	331.6	600		
Las Vegas #3	137	335	675		
Boulder City	134	437.9	120		
Caliente	055	507.3	4320		
St. George C	082	691.7	2000		
St. George F	082	695.2	1930		
Cedar City C	069	893	1530		
Cedar City F	069	897.9	1640		
Goldfield C	312	497		480	
Goldfield F	312	502		516	
Bishop C	285	748.2		2046	
Bishop F	285	752.8		1160	
Albuquerque	110	2920		(2)	
Pasadena	215	1160		200	

(1) Broke small windows.

(2) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Harry DATE 5/19/53 TIME 1205 Z

YIELD 32.4 kt BURST HEIGHT 300 ft. LOCATION T-3A

APPARENT BLAST YIELD, W_a = 63.9 kt, $W_a^{0.4}$ 5.26

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Mercury	176	139.0	2000		
Indian Springs C	151	187	>3200		
Indian Springs F	151	191.4	2464		
Las Vegas C	143	412	2380	186	
Las Vegas F	143	417.1	2210	194	
Boulder City	139	527.9	850	238	
Caliente	065	486.1	310	240	
St. George C	089	710.6	540	252	18
St. George F	089	715	505	252	24
Cedar City C	075	891	90	120	60
Cedar City F	075	895.2	80	140	60
Goldfield C	304	421		640	
Goldfield F	304	425		720	
Bishop C	279	700.3		1488	223
Bishop F	279	705.0		1320	160
Pasadena	212	1218		350	135
Albuquerque	110	2890	6	24	

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Grable DATE 5 /25 /53 TIME 1530 Z

YIELD 14.9 kt BURST HEIGHT 524 ft. LOCATION FF

APPARENT BLAST YIELD , W_a = 33.4 kt, $W_a^{0.4}$ 4.07

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	324	61.7	14700		
Mercury	200	53.3	7440		
Groome Mine	020	203	15000		
Indian Springs C	141	97.5	> 960		
Indian Springs F	141	102.0	> 960		
Las Vegas C	137	327	123	336	
Las Vegas F	137	331.6	112	269	
Boulder City	134	437.9	36	168	
Caliente	055	507.3	2760		
St. George C	082	691.7	1650		
St. George F	082	695.2	1800		
Cedar City C	069	893	1320		
Cedar City F	069	897.9	1160		
Goldfield C	312	497	1125	280	
Goldfield F	312	502	920	260	
Bishop C	285	748.2		1140	
Bishop F	285	752.8		1590	
Pasadena	215	1160		140	60
Albuquerque	110	2920		(1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Upshot-Knothole EVENT Climax DATE 6 /4 /53 TIME 1115 Z

YIELD 60.8 kt BURST HEIGHT 1334 ft. LOCATION T-7-3

APPARENT BLAST YIELD, W_a = 165.1 kt, $W_a^{0.4}$ 7.70

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	191	55.3	22800		
Mercury	177	154.9	3200		
Indian Springs C	154	201	465		
Indian Springs F	154	205.0	485		
Las Vegas C	144	424		180	
Las Vegas F	144	429.0		180	
Las Vegas #3	144	433	40	220	
Boulder City	140	539.0		390	
Caliente	067	477.7	180	280	
St. George C	090	708.6		160	170
St. George F	090	713		140	180
Cedar City C	076	885		110	140
Cedar City F	076	889.2		100	120
Goldfield C	304	421	120	300	
Goldfield F	304	425	120	240	
Bishop C	277	699.2		2040	
Bishop F	277	703.9		2460	
Pasadena	212	1218		300 (1)	
Albuquerque	110	2890		63.5	

(1) Newspapers headline "Mysterious Blast Rocks LA."

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Wasp DATE 2 /18 /55 TIME 2000 Z

YIELD 1.2 kt BURST HEIGHT 762 ft. LOCATION T-7-4

APPARENT BLAST YIELD , W_a = 5.72 kt, $W_a^{0.4}$ 2.01

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	191	55.3	5040		
Mercury	177	155.2	2070		
Indian Springs	154	205.4	2663		
Las Vegas	142	421.5	670	360	
Boulder City	140	531.6	530	140	
Caliente	067	478.7		1600	
St. George	090	710.1	40	260	
Cedar City	075	889		280	
Lund	024	708		192	
Tonopah	318	474.6		154	
Bishop	278	700.2		(1)	
Inyokern	224	700.4		(1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Moth DATE 2 /22 /55 TIME 1345 Z

YIELD 2.4 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD , W_a = 5.45 kt, $W_a^{0.4}$ 1.97

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	194	41.8	14640		
Mercury	177	141.5	5800		
Indian Springs	152	193.2	5544		
Las Vegas	143	418.6	2992	88	
Boulder City	139	521.9	1121	162	
Caliente	065	483.7	32	1088	
St. George	089	709.3	232	1032	
Cedar City	075	893.3	72.6	386	
Lund	024	720.1	3.6	389	
Tonopah	320	483.5		62.4	
Bishop	279	701.1		4.2	>96
Inyokern	224	689.8	4.1	33.6	52.3

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Tesla DATE 3 / 1 /55 TIME 1330 Z

YIELD 6.8 kt BURST HEIGHT 300 ft. LOCATION T-9B

APPARENT BLAST YIELD , W_a = 14.7 kt, $W_a^{0.4}$ 2.93

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	182	69.3	11280		
Mercury	175	170.3	2088		
Indian Springs	154	221.9	> 2232		
Las Vegas	144	445.8	> 311	164.8	14
Boulder City	140	548.3	160	344	
Caliente	069	479.4	348	524	
St. George	092	716.5	329	>> 960	
Lund	025	702.4	126	>> 888	
Tonopah	318	457.0	21.0	126	
Bishop	276	689.1			51.0
Inyokern	222	704.7		13.2	104.8

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Turk DATE 3/7 /55 TIME 1320 Z

YIELD 43 kt BURST HEIGHT 500 ft. LOCATION T-2

APPARENT BLAST YIELD , W_a = ______ kt, $W_a^{0.4}$ ______

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	166	76.2	>14880 (1)		
Mercury	168	178.1	1760		
Indian Springs	150	235.9	416		
Las Vegas	143	461.9	54.0	480	
Boulder City	139	565.3	48	454	
Caliente	070	496.7	240	1410	
St. George	092	737.0	60	4080	
Lund	027	706.9	48	4128	
Tonopah	320	440.1	1464	562	
Bishop	276	668.2	13.2	138	94.2
Beatty	244	210	1144		
Inyokern	221	699.1	10	80	124

(1) Δp >12 mb.

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Hornet DATE 3 / 12 / 55 TIME 1320 Z

YIELD 3.6 kt BURST HEIGHT 300 ft. LOCATION T-3A

APPARENT BLAST YIELD , W_a = 7.85 kt, $W_a^{0.4}$ 2.28

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	193	39.1	13080		
Mercury	176	139.0	1560		
Indian Springs	151	191.4	728		
Las Vegas	143	417.1	42.0	148.8	
Boulder City	139	520.6	12.0	184.2	
Glendale	110	459	94.8	202.8	
Caliente	065	486.1	60	210	
St. George	089	710.6	20	256	
Lund	024	728.0		410	
Tonopah	320	484.8		256.8	
Bishop	279	700.3		120	60
Inyokern	224	691.7		126.6	33.0

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Bee DATE 3/22/55 TIME 1305 Z

YIELD 8.1 kt BURST HEIGHT 500 ft. LOCATION T-7-1

APPARENT BLAST YIELD, W_a = 19.05 kt, $W_a^{0.4}$ 3.25

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	189	58.8	13200		
Mercury	177	158.7	7703		
Indian Springs	154	208.7	5685		
Las Vegas	144	432.7	2904	216	
Henderson	141	493	2416	432	
Boulder City	140	542.5	1440	280	
Caliente	067	477.3		548	
St. George	091	709.7	36	3120	
Lund	025	709.7		900	
Tonopah	318	469.9		108	
Bishop	277	697.5		49.5	22.8
Inyokern	223	706.1	12	24	

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT ESS DATE 3/23/55 TIME 2030 Z

YIELD 1.1 kt BURST HEIGHT -67 ft. LOCATION T-10

APPARENT BLAST YIELD, W_a = ______ kt, $W_a^{0.4}$ ______

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	182	85.7	400		
FFT	176	133.2	384		
Mercury	176	186.4	230		
Indian Springs	156	235.9	16		
Las Vegas	146	458.1	<20 (1)		
Boulder City	141	559.7		63	
Caliente	071	472.1		260	
St. George	093	715.3		166	
Lund	026	687.1		358	
Tonopah	317	446.0		<48 (1)	
Bishop	275	688.6		12	6
Inyokern	221	722.2		7.6	13

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Apple-I DATE 3/29/55 TIME 1255 Z

YIELD 14.2 kt BURST HEIGHT 500 ft. LOCATION T-4

APPARENT BLAST YIELD, W_a = 31.3 kt, $W_a^{0.4}$ 3.96

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	167	59.9	6120		
Mercury	169	161.9	2240	280	
Indian Springs	149	220.2	3840	315	
Las Vegas	142	446.9	2040	285	
Boulder City	138	558.0	1624	488	
Caliente	068	498.4	340	550	
St. George	091	732.7	255	1452	
Lund	026	719.1	632	760	
Tonopah	320	454.9		160	
Bishop	277	674.7		44.4	28.5
Inyokern	222	690.4		192	36

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Wasp-Prime DATE 3/29/55 TIME 1800 Z

YIELD 3.2 kt BURST HEIGHT 740 ft. LOCATION T-7-4

APPARENT BLAST YIELD, W_a = 11.6 kt, $W_a^{0.4}$ 2.67

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	191	55.3	4068		
Mercury	177	154.9	204	42	
Indian Springs	154	205.0	408	187	
Las Vegas	144	429.0	>320	248	
Boulder City	140	531.7	696	583	
Caliente	067	477.7	2320	496	160
St. George	090	708.6	308	368	
Tonopah	318	473.5		35	
Bishop	277	703.9		14.4	24.0
Inyokern	224	699.6		91.8	

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT HA DATE 4/6/55 TIME 1800 Z

YIELD 3.3 kt BURST HEIGHT 36,620 ft. LOCATION T-5G

APPARENT BLAST YIELD, W_a = 3.3 kt, $W_a^{0.4}$ 1.612

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1-P (1)	179	47.0	13200		
FFT-P (1)	170	89.2	7760 (2)		
MER-P (1)	172	140.0	2208 (2)		
Indian Springs	148	192.5	1002		
Las Vegas	141	419.7	42	138	
Boulder City	138	531.2		572	
Caliente	065	496.4		474	
St. George	089	720.3		756	
Lund	025	735.7		204	
Tonopah	321	482.1		65.4	
Bishop	279	691.8			54.0
Inyokern	224	681.9		20	78

(1) MB sensor on 40-foot pole.
(2) No step recorded to show reflected wave.

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Post DATE 4/ 9 /55 TIME 1230 Z

YIELD 1.5 kt BURST HEIGHT 300 ft. LOCATION T-9C

APPARENT BLAST YIELD , W_a = 3.6 kt, $W_a^{0.4}$ 1.67

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
OBA	183	63.7	7200		
CP-1	185	68.4	4680		
Mercury	176	168.9	340		
Indian Springs	154	219.0	180		
Las Vegas	145	442.6	87		
Boulder City	141	552.1		342	
Caliente	069	476.3		207	
St. George	092	712.7		1014	
Lund	025	701.9		626	
Tonopah	318	460.4	3.6	58.2	
Bishop	276	693.0		19.2	10.2
Inyokern	222	711.1		51.0	

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT MET DATE 4/15/55 TIME 1915 Z

YIELD 22.0 kt BURST HEIGHT 400 ft. LOCATION FF

APPARENT BLAST YIELD, W_a = 45.1 kt, $W_a^{0.4}$ 4.58

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	323	61.7	>8880 (1)		
OBA	200	34.5	24400		
Mercury	200	53.3	>>3200		
Indian Springs	141	102.0	>3200 (2)		
Las Vegas	137	331.6	410	256	
Boulder City	134	437.9	110	552	
Caliente	055	507.3	1200	320	
St. George	082	691.7	354	4540	
Lund	020	800.2	48.0	714	60
Tonopah	323	571.9		554	
Bishop	285	748.2		114	
Inyokern	232	654.9		290	98

(1) Estimated 11,000.
(2) Estimated 3,600.

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Apple-II DATE 5/ 5 /55 TIME 1210 Z

YIELD 28.5 kt BURST HEIGHT 500 ft. LOCATION T-1

APPARENT BLAST YIELD , W_a = 59.9 kt, $W_a^{0.4}$ 5.14

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	162	44.8	21300		
Mercury	167	146.6	620		
Indian Springs	146	207.0	182.4	256	
Las Vegas	141	434.9	492	422	70.8
Boulder City	147	546.7		960	80
Caliente	067	504.5	84.8	>160	71.0
St. George	090	733.0		>840	125.4
Lincoln Mine	027	238	5112		
Lund	026	733.0	724	416	
Tonopah	322	467.1	1960	120	304
Bishop	279	677.3		744	69.0
Inyokern	223	679.2		500	

MICROBAROGRAPH DATA SUMMARY

OPERATION Teapot EVENT Zucchini DATE 5/15/55 TIME 1200 Z

YIELD 28.2 kt BURST HEIGHT 500 ft. LOCATION T-7-1

APPARENT BLAST YIELD, W_a = 59.2 kt, $W_a^{0.4}$ 5.10

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	189	58.8	12480		
Mercury	177	158.7	2100		
Indian Springs	154	208.7	825		
Las Vegas	154	432.7	664	160	
Boulder City	140	535.3	480	260	
Glendale	110	458	1170		
Caliente	067	477.3	1830	120	
St. George	091	709.7	1680	120	
Lund	025	709.7	300	870	
Tonopah	318	469.9	155.4	295.2	
Bishop	277	697.5		540	
Inyokern	223	706.1		460	

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Boltzmann DATE 5/28/57 TIME 1155 Z

YIELD 11.5 kt BURST HEIGHT 500 ft. LOCATION T-7C

APPARENT BLAST YIELD, W_a = 26.1 kt, $W_a^{0.4}$ 3.69

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	189	58.8	5976		
Las Vegas	143	423.9		202.2	
Boulder City	140	535.3		177.0	34.2
St. George	091	709.7		92.4	76.2
Tonopah	318	469.9	48	268	
Bishop	277	697.5	12	480	
Inyokern	223	701.4		1152	26.0

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Franklin DATE 6/2/57 TIME 1155 Z

YIELD 0.14 kt BURST HEIGHT 300 ft. LOCATION T-3

APPARENT BLAST YIELD, W_a = 0.569 kt, $W_a^{0.4}$ 0.798

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	194	41.9	6800		
Las Vegas	141	410.8	3.0	24.6	
Boulder City	139	521.9	1.2	24.6	
St. George	089	709.3		6.6	21.0
Tonopah	320	483.5	6	48	
Bishop	279	701.1		254.4	
Inyokern	224	689.8		568	20

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Lassen DATE 6/5/57 TIME 1145 Z

YIELD 0.47-ton BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD, $W_a = 4.7 \times 10^{-4}$ kt, $W_a^{0.4}$ 4.97×10^{-2}

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	184	73.2	80		
Las Vegas	144	445.8		0.4	
Boulder City	140	548.3		0.4 (1)	
St. George	092	716.5		0.4 (1)	
Tonopah	318	457.0		0.8	
Bishop	277	689.0		14	
Inyokern	222	704.7		6.0	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Wilson DATE 6/18/57 TIME 1145 Z

YIELD 10.3 kt BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD, W_a = 23.4 kt, $W_a^{0.4}$ 3.52

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	177	72.7	4620		
Las Vegas	144	447.4	17.4	97.8	
Boulder City	140	549.6		75.0	
St. George	092	714.9	149.4	40.2	82.2
Lund	025	698.8	30.6	218.4	
Tonopah	318	455.8	26	182	
Bishop	277	690.4		1160	
Inyokern	222	708.3		800	24

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Priscilla DATE 6/24/57 TIME 1330 Z

YIELD 36.6 kt BURST HEIGHT 700 ft. LOCATION B-FF

APPARENT BLAST YIELD, W_a = 81.7 kt, $W_a^{0.4}$ 5.80

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	323	61.7	24000 (1)		
Mercury	200	53.3	12960 (2)		
Las Vegas	135	325.4	85.2	112.2	25.8
Boulder City	134	437.9	26.4	96.0	
St. George	082	691.7	14.4	58.8	66.0
Lund	020	800.1	6.0	120	38
Tonopah	323	571.9		704	
Bishop	285	748.7		1650	144
Inyokern	232	650.4		1566	
San Diego	196	1528		(3)	

(1) Δp = 17.52 mb = 0.254 lb/in.^{2}.
(2) Door torn off house at Indian Springs, no MB recorder.
(3) No MB recorder, audible disturbance.

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Hood DATE 7 / 5 /57 TIME 1140 Z

YIELD 74.3 kt BURST HEIGHT 1500 ft. LOCATION B-9A

APPARENT BLAST YIELD , W_a = 208.5 kt, $W_a^{0.4}$ 8.46

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
Indian Springs	155	224.1	540		
Las Vegas	145	447.4	30	198	42
Boulder City	140	549.6		126	57
St. George	092	714.9	24	73.1	168
Lund	025	698.8	269	365	221
Tonopah	318	455.8	610	390	
Bishop C	277	690.4		2760	90
Bishop F	277	694.6		2280	
Inyokern	222	708.3		1728	108
Gov't Peak	226	790		3240	108
Daggett	203	765		928	156

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Diablo DATE 7 /15 / 57 TIME 1130 Z

YIELD 17.0 kt BURST HEIGHT 500 ft. LOCATION T-2B

APPARENT BLAST YIELD , W_a = 37.1 kt, $W_a^{0.4}$ 4.24

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	166	79.8	8150		
Las Vegas	143	463.7	7.2	113.2	10.2
Boulder City	139	566.8		54	40.8
St. George	092	734.8		15.6	93.5
Lund	027	702.0	12	97	104
Tonopah	320	438.3	182	64.8	
Bishop C	276	670.2		1040	
Bishop F	276	674.9		1616	
Inyokern	221	699.7		1768	50

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT John DATE 7/19/57 TIME 1400 Z

YIELD 2 kt BURST HEIGHT 30,000 ft. LOCATION A-9

APPARENT BLAST YIELD, W_a = 2 kt, $W_a^{0.4}$ 1.32

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	177	74.4	2440		
Las Vegas	144	447.4	3.0	73.2	
Boulder City	140	549.6		66	12
St. George	092	714.9		34.2	45
Lund	025	698.8	22.8	52.8	63
Tonopah	318	455.8	6	60.2	
Coaldale	302	618.5		284	20
Bishop	277	690.4		556	
Inyokern	222	708.3		800	40

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Kepler DATE 7/24/57 TIME 1150 Z

YIELD 10.3 kt BURST HEIGHT 500 ft. LOCATION T-4

APPARENT BLAST YIELD, W_a = 23.5 kt, $W_a^{0.4}$ 3.53

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	167	59.9	14320		
Las Vegas	140	434.9	22	96	
Boulder City	138	551.8	57	128	
St. George	091	734.5		34	72
Lund	026	720.0	18.4	160	52
Tonopah	320	450.0	37.2	198	
Coaldale	304	618		870	
Sodaville	308	792		1020	
Bishop	278	674.8		840	
Inyokern	222	685.0		1332	

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Owens DATE 7/25/57 TIME 1330 Z

YIELD 9.7 kt BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD , W_a = 22.2 kt, $W_a^{0.4}$ 3.46

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	183	72.7	7740		
Las Vegas	144	447.4	57		
Boulder City	140	549.6		39	33
St. George	092	714.9	9.6	29	78
Lund	025	698.8	10.7	12.0	
Tonopah	318	455.8	110	246	
Sodaville	306	725.5		870	
Bishop C	277	690.4		690	
Bishop F	277	693		780	90
Inyokern	222	708.3		780	

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Stokes DATE 8 / 7 / 57 TIME 1225 Z

YIELD 19.1 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = 76.0 kt, $W_a^{0.4}$ 5.66

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	185	48.7	>16000		
CP-1	189	55.8	16640		
Las Vegas	144	430.2	8.0	89.6	
Boulder City	140	532.9		81.0	
St. George	091	709.2	11.6	43.4	70.4
Lund	025	712.4	797	157	37.8
Tonopah	318	472.2	725	178.2	
Bishop	277	697.8		1440	
Inyokern C	223	694.2		638	100
Inyokern F	223	698.9		896	

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Shasta DATE 8 /18/57 TIME 1200 Z

YIELD 16.5 kt BURST HEIGHT 500 ft. LOCATION T-2A

APPARENT BLAST YIELD , W_a = 35.8 kt, $W_a^{0.4}$ 4.19

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	165	64	10640		
CP-1	166	71.6	7360		
Las Vegas	143	456.7	28.8	147	
Boulder City	139	560.0	12	152	7.2
St. George	092	733.7	1.8	48	48
Lund	027	709.1	36	391	36
Tonopah	320	445.1	1103	220	
Bishop	276	671.9	48	486	48

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Doppler DATE 8/23/57 TIME 1230 Z

YIELD 10.7 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD, W_a = 49.0 kt, $W_a^{0.4}$ 4.74

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	185	48.7	17640		
CP-1	189	55.8	13500		
Las Vegas	144	430.2	1.8	141	
Boulder City	140	532.9	1.2	165	
St. George	091	709.2	6	51.6	85.7
Lund	025	712.4	30	180	50
Tonopah	318	472.2	428	222.4	
Bishop	277	697.8		780	48
Inyokern	223	698.9		948	54

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Franklin Prime DATE 8/30/57 TIME 1240 Z

YIELD 4.7 kt BURST HEIGHT 750 ft. LOCATION B-7B

APPARENT BLAST YIELD, W_a = 10.44 kt, $W_a^{0.4}$ 2.56

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	185	48.7	5220		
CP-1	189	55.8	6160		
Las Vegas	144	430.2	11	92.8	
Boulder City	140	532.9		151.2	
St. George	091	709.2	16	66.2	46
Lund	025	712.4	24	120	33
Tonopah	318	472.2	66	158	
Bishop	277	697.8		944	40
Inyokern	223	698.9		620	90
Daggett	203	790		570	100

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Smokey DATE 8/31/57 TIME 1230 Z

YIELD 44 kt BURST HEIGHT 700 ft. LOCATION T-2C

APPARENT BLAST YIELD , W_a = 96.5 kt, $W_a^{0.4}$ 6.22

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	190	91.8	15200		
Las Vegas	143	467.6	138	204	
Boulder City	139	585.2	60	204	16
St. George	092	723.8	234	167	42.6
Lund	027	684.8	4.8	317	84.5
Tonopah	320	435.6	7.2	660	
Bishop	276	680.5		1080	280
Inyokern	221	717.5		918	96
Daggett	203	790	108	900	90

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Galileo DATE 9/2 /57 TIME 1240 Z

YIELD 11.4 kt BURST HEIGHT 500 ft. LOCATION T-1

APPARENT BLAST YIELD, W_a = 25.7 kt, $W_a^{0.4}$ 3.66

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	160	38.5	38300		
CP-1	162	44.8	16680		
Las Vegas	141	427.7	21	156	24
Boulder City	137	539.5	6	156	6
St. George	090	733.0		108	
Lund	026	733.0	12	408	158
Tonopah	322	467.1	186	504	
Bishop	279	677.3		420	18
Inyokern	223	674.6		510	60

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Wheeler DATE 9/ 6 /57 TIME 1245 Z

YIELD 0.197 kt BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD , W_a = 1.025 kt, $W_a^{0.4}$ 1.01

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	180	64.1	3200		
CP-1	183	72.7	1710		
Las Vegas	144	447.4		28.6	
Boulder City	140	549.6	1.2	41.0	
St. George	092	714.9		30	
Lund	025	698.8	12	180	
Tonopah	318	455.8	123	18	
Bishop	277	690.4	3.0	45	15
Inyokern	222	708.3		50	30

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT LaPlace DATE 9/8 /57 TIME 1300 Z

YIELD (Not released) kt BURST HEIGHT 750 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = ________ kt, $W_a^{0.4}$ ________

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	185	48.7	12600		
CP-1	189	55.8	5600		
Las Vegas	144	430.2	10	52	
Boulder City	140	532.9		150	
St. George	091	709.2	3	41	14
Lund	025	712.4	6	60	6
Tonopah	318	472.2	15	79.5	33
Bishop	277	697.8	6	240	15
Inyokern	223	698.9		492	66

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Fizeau DATE 9 / 14 / 57 TIME 1645 Z

YIELD 11.1 kt BURST HEIGHT 500 ft. LOCATION T-3B

APPARENT BLAST YIELD, W_a = 25.3 kt, $W_a^{0.4}$ 3.64

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	190	29.0	30480		
Las Vegas	143	417.1	30.6	141	15
Boulder City	139	520.6	12.6	216	
St. George	089	710.6	4.8	171	98.4
Lund	024	728.0	2.4	163.2	45
Tonopah	320	484.8	18	121.8	
Bishop	279	700.3		280	76
Inyokern	224	691.7		346	30

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Newton DATE 9 /16 /57 TIME 1250 Z

YIELD 12 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = 53.6 kt, $W_a^{0.4}$ 4.91

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	189	55.8	11100		
Las Vegas	144	430.2	96	133.5	
Boulder City	140	532.9	50	195	
Glendale	110	448	475	90	
St. George	091	709.2	496	128	
Lund	025	712.4	56	220	34
Tonopah	318	472.2	6	396	
Bishop	277	697.8		550	70
Inyokern	223	698.9		1000	100

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Rainier DATE 9/19/57 TIME 1700 Z

YIELD 1.7 kt BURST HEIGHT -790 ft. LOCATION U-126

APPARENT BLAST YIELD , W_a = ______ kt, $W_a^{0.4}$ ______

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	151	95	(1)		
CP-1	154	101.5	(1)		
Las Vegas	141	483.1	(1)		
Boulder City	138	591.4	(1)		
St. George	092	761	2.4		
Lund	029	707.5	(1)		
Tonopah	318	467.3		(1)	
Bishop	276	652.1		5.4	
Inyokern	219	699.6		(1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Whitney DATE 9 /23 /57 TIME 1230 Z

YIELD 18.5 kt BURST HEIGHT 500 ft. LOCATION T-2

APPARENT BLAST YIELD , W_a = 40.0 kt, $W_a^{0.4}$ 4.37

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	163	69.3	5400		
CP-1	166	76.2	4300		
Las Vegas	143	454.2	12	210	18
Boulder City	139	565.3	30	280	
St. George	092	737.0	9.0	336	
Lund	027	706.9	49.2	696	
Tonopah	320	440.1	300	210	
Bishop	276	668.1		340	120
Inyokern	221	694.4		330	20

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Charleston DATE 9/28/57 TIME 1300 Z

YIELD 11.5 kt BURST HEIGHT 1500 ft. LOCATION B-9A

APPARENT BLAST YIELD, W_a = 52.6 kt, $W_a^{0.4}$ 4.88

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	183	72.7	4680		
Las Vegas	145	447.4		156	
Boulder City	140	549.6		408	
St. George	092	714.9	30	268	20
Lincoln Mine	022	164	5160		
Lund	025	698.8	1069	180	
Tonopah	318	455.8	96	90	
Bishop	277	690.4		152	34
Inyokern	222	708.3		318	48
Daggett	203	865		190	76

MICROBAROGRAPH DATA SUMMARY

OPERATION Plumbbob EVENT Morgan DATE 10/ 6 /57 TIME 1300 Z

YIELD 8 kt BURST HEIGHT 500 ft. LOCATION B-9A

APPARENT BLAST YIELD, W_a = 18.96 kt, $W_a^{0.4}$ 3.24

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	183	72.7	8640		
Las Vegas	145	447.4		148	
Boulder City	140	549.6	84	376	
Alamo	069	275	>960		
Coyote	064	317	2320		
St. George	092	714.9	480	422	
Lund	025	698.8	367	542	
Tonopah	318	455.8	206	168	
Bishop	277	690.4		42.0	57.6
Inyokern	222	708.3		145.2	15

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Eddy DATE 9 / 19 / 58 TIME 1400 Z

YIELD 83-ton BURST HEIGHT 500 ft. LOCATION B-7B

APPARENT BLAST YIELD, W_a = 0.34 kt, $W_a^{0.4}$ 0.65

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	185	46.5	3040		
CP-1	189	55.0	2588		
MOB	189	55.8	1880		
Las Vegas	144	430.2	1.2	11	
Boulder City	140	532.9	0.8	11.8	
St. George	091	709.2		12.8	
Bishop	277	697.8		66.6	
Inyokern	223	698.9		48.6	4.8

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Mora DATE 9 /29 / 58 TIME 1405 Z

YIELD 2 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = 7.76 kt, $W_a^{0.4}$ 2.27

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	189	55.8	17500		
FFO	178	143	6020		
Las Vegas	144	430.2	210	60	
Boulder City	140	532.9	28	50	
St. George	091	709.2		408	
Bishop	277	697.8		71.4	18
Inyokern	223	698.9	10	176	44

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Hidalgo DATE 10/ 5 /58 TIME 1410 Z

YIELD 77-ton BURST HEIGHT 377 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = 0.393 kt, $W_a^{0.4}$ 0.689

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	185	46.5	2540		
CP-1	189	55.8	2640		
Las Vegas	144	430.2	18	5.8	
Boulder City	140	532.9	28.4	34	
St. George	091	709.2		53.4	
Bishop	277	697.8		6	9
Inyokern	223	698.9		6.6	29

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Quay DATE 10/10/58 TIME 1430 Z

YIELD 79-ton BURST HEIGHT 100 ft. LOCATION T-7C

APPARENT BLAST YIELD, W_a = 0.182 kt, $W_a^{0.4}$ 0.506

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	191	43.6	3180		
CP-1	188	59.0	4250		
Las Vegas	144	432.9		14	
Boulder City	140	535.5		22	
St. George	091	709.5	3.2	217.6	7.0
Bishop	278	697.1		4.5	
Inyokern	223	701.2		7.0	

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Lea DATE 10/ 13/58 TIME 1320 Z

YIELD 1.4 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = 4.37 kt, $W_a^{0.4}$ 1.80

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	185	55.8	7200		
CP-1M	185	55.8	6300		
Las Vegas	144	430.2	10.6	59	
Boulder City	140	531.7		102	
St. George	091	709.2		344	
Bishop	278	697.8		30.6	26.4
Inyokern	223	698.9		57.0	18.4

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Hamilton DATE 10/15/58 TIME 1600 Z

YIELD 1.17-ton BURST HEIGHT 50 ft. LOCATION FF-T-1

APPARENT BLAST YIELD, W_a = 4.11×10^{-3} kt, $W_a^{0.4}$ 0.111

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	323	61.7	732		
Las Vegas	137	326		<1.6 (1)	
Boulder City	134	437.9		1	
St. George	082	691.7		20	
Bishop	285	748.7	2	1	
Inyokern	232	650.4		<1 (1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Dona Ana DATE 10/16/58 TIME 1420 Z

YIELD 37-ton BURST HEIGHT 500 ft. LOCATION B-7B

APPARENT BLAST YIELD , W_a = 0.0904 kt, $W_a^{0.4}$ 0.373

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	185	55.8	4620		
Las Vegas	144	430.2		5.0	
Boulder City	140	532.9		5.0	
St. George	091	709.5		139	
Bishop	278	697.8		<0.3 (1)	
Inyokern	223	698.9		1.0	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Rio Arriba DATE 10/18/58 TIME 1425 Z

YIELD 90-ton BURST HEIGHT 70 ft. LOCATION T-3S

APPARENT BLAST YIELD , W_a = 0.187 kt, $W_a^{0.4}$ 0.512

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	190	32.9	3600		
CP-1	194	41.8	2400		
Las Vegas	143	418.6	4	18	
Boulder City	139	529.1		33	
St. George	089	709.3	6	216	
Bishop	279	701.1		2	13
Inyokern	224	689.8		(1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Vesta DATE 10/ 18/ 58 TIME 2300 Z

YIELD 24-ton BURST HEIGHT 0 ft. LOCATION GG-9

APPARENT BLAST YIELD, W_a = 0.0456 kt, $W_a^{0.4}$ 0.290

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
BJY	205	22.3	630		
CP-1	184	69.9	37.0		
Las Vegas	145	446		3.6	
Boulder City	141	556		11.4	
St. George	092	714	>96		
Bishop	276	691	12	<6 (1)	
Inyokern	222	708		3	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Socorro DATE 10/22/58 TIME 1330 Z

YIELD 6 kt BURST HEIGHT 1500 ft. LOCATION B 7B

APPARENT BLAST YIELD , $W_a =$ 30.36 kt, $W_a^{0.4}$ 3.92

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	187	47.5	22800		
CP-1	190	55.8	18960		
Las Vegas	144	430.2	160.8	146.4	
Boulder City	140	532.9	64.2	237.6	
Coyote	050	233	3624		
St. George	091	709.2	240	1398	60
Bishop	278	697.8		1.62	12.6
Inyokern	223	698.9		13	16

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Wrangell DATE 10/22/58 TIME 1650 Z

YIELD 0.115 kt BURST HEIGHT 1500 ft. LOCATION B-FF

APPARENT BLAST YIELD, W_a = 0.115 kt, $W_a^{0.4}$ 0.421

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	323	61.7	3720		
UCC	328	67.9	3540		
Las Vegas	135	325.4	33.0	9.6	
Boulder City	134	437.9	17.4	18.6	
Coyote	033	288	3540		
St. George	082	691.7		210	
Bishop	285	748.7	9		12
Inyokern	232	650.4		<4 (1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Rushmore DATE 10/22 /58 TIME 2340 Z

YIELD 0.188 kt BURST HEIGHT 500 ft. LOCATION B-9B

APPARENT BLAST YIELD , W_a = 0.960 kt, $W_a^{0.4}$ 0.984

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	180	64.2	600		
CP-1	183	72.7	440		
Las Vegas	145	447.4	5.0	26.0	
Boulder City	140	549.6	2.0	92	11
Coyote	050	225	330		
St. George	092	714.9		220	
Bishop	277	690.4			36
Inyokern	222	708.3		2	

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Catron DATE 10/24/58 TIME 1500 Z

YIELD 0.021 kt BURST HEIGHT 72.5 ft. LOCATION T-3

APPARENT BLAST YIELD, W_a = 0.0498 kt, $W_a^{0.4}$ 0.299

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	190	27.3	4800		
CP-1	194	41.8	3120		
Las Vegas	143	410.8	2.7	11.5	14
Boulder City	139	521.9		21	8
Coyote	050	214	72		
St. George	089	709.3		150	
Bishop	279	701.1		(1)	
Inyokern	224	689.8		(1)	

(1) No signal/noise.

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Sanford DATE 10/26/58 TIME 1020 Z

YIELD 4.9 kt BURST HEIGHT 1500 ft. LOCATION B-FF

APPARENT BLAST YIELD, W_a = 25.0 kt, $W_a^{0.4}$ 3.62

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
CP-1	323	61.7	11400		
BJY	338	103.3	7600		
Mercury	200	53.3	7600		
Las Vegas	135	325.4	312	156	
Boulder City	134	437.9	1140	78	
St. George	082	691.7	750	1920	
Bishop	285	748.7		7.8	35.4

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT DeBaca DATE 10/26/68 TIME 1600 Z

YIELD 2.2 kt BURST HEIGHT 1500 ft. LOCATION B-7B

APPARENT BLAST YIELD, W_a = 8.93 kt, $W_a^{0.4}$ 2.41

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	187	47.5	15300		
CP-1	190	55.8	10380		
Mercury	178	155.6	468		
Las Vegas	144	430.2	15.3	78	
Boulder City	140	532.9		456	
St. George	091	709.2	348	1590	
Bishop	277	697.8		9	72
Inyokern	223	701.2		9.6	55.6

MICROBAROGRAPH DATA SUMMARY

OPERATION Hardtack II EVENT Chavez DATE 10/27 /58 TIME 1430 Z

YIELD (Not Released) kt BURST HEIGHT 52. 5 ft. LOCATION A-3

APPARENT BLAST YIELD , W_a = ______ kt, $W_a^{0.4}$ ______

MB STATION	AZIMUTH (DEG.)	RANGE (KFT)	RECORDED PEAK-TO-PEAK PRESSURE AMPLITUDE (MICROBARS)		
			TROPO-SPHERE	OZONO-SPHERE	IONO-SPHERE
UCC	193	34. 7	1476		
CP-1	194	41. 8	1402		
Las Vegas	143	410. 8		6	2
Boulder City	139	521. 9		8. 7	
St. George	089	709. 3		13	
Bishop	279	701. 1		3. 3	1. 2
Inyokern	224	689. 8		(1)	

(1) No signal/noise.

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